

ROADS AND STREETS

SEPTEMBER 1950



New Lorain-50 "Series" revolves on new TIMKEN® cone rollers

Four cone rollers in the new Lorain-50 "Series" power shovels and cranes carry the weight of the bucket load and entire upper structure above the crawler or rubber-tired carrier. Cone rollers, a new development of the Timken Company, assure a free, easy swing. Each cone roller is a complete Timken® tapered roller bearing—and it is the cone-shaped outer race of the Timken bearing upon which the turntable revolves.

Because of tapered design, Timken cone rollers take both radial and thrust loads. Line contact between rollers and races gives extra load-carrying capacity. Due to true rolling motion and smooth surface finish, Timken cone rollers minimize friction.

No other bearing offers *all* the advantages you get with Timken bearings. Look for the trade-mark "Timken" on every bearing. The Timken Roller Bearing Company, Canton 6, Ohio. Cable address: "TIMROSCO".



TIMKEN
TRADE-MARK REG. U. S. PAT. OFF.
TAPERED ROLLER BEARINGS



**13 LPC MOTOR SCRAPERS
MOVING 3½ MILLION
TOUGH YARDS!**

**LIST & CLARK, General Contractor, and
PERRY McGLONE, Sub-Contractor, are
using LaPLANT-CHOATE MOTOR SCRAPERS
on the Burlington R. R. relocation job in
Northwest Missouri**

3½ MILLION YARDS of tough heavy material to be moved on a job 42 miles long! That's the kind of earthmoving that calls for rugged, broad shouldered power, big capacity and dependable high speed operation. List & Clark with seven TS-300's and Perry McGlone with six depend on LPC Motor Scraper performance to lick this tough job at a profit-setting pace.

The Motor Scraper has many high production features worth knowing about—ask your LPC Distributor to show you these units in action—get the whole story from men who own or operate them. LaPlant-Choate Manufacturing Co., Inc., Cedar Rapids, Iowa — LaPlant-Choate Sales and Service, 1022 77th Avenue, Oakland, California.

LAPLANT



CHOATE



Cable-operated Scrapers in 6-, 8- and 16-yd. sizes for all makes of track-type tractors.



2- and 4-yd. Scrapers for track-type and rubber-tired industrial tractors.



Hydraulic and Cable-operated Scrapers.

On the Turnpike Extension

By extending the eastern end of the famous Pennsylvania Turnpike from Middlesex, Pa., to King of Prussia, northwest of Philadelphia, the Pennsylvania Turnpike Commission has brought closer its goal of a limited-access toll road spanning the Keystone State from east to west. The accompanying pictures were taken at various points along the new 100-mile Turnpike extension, and show representative uses of some of the steel products furnished by Bethlehem for this most famous of express highways.

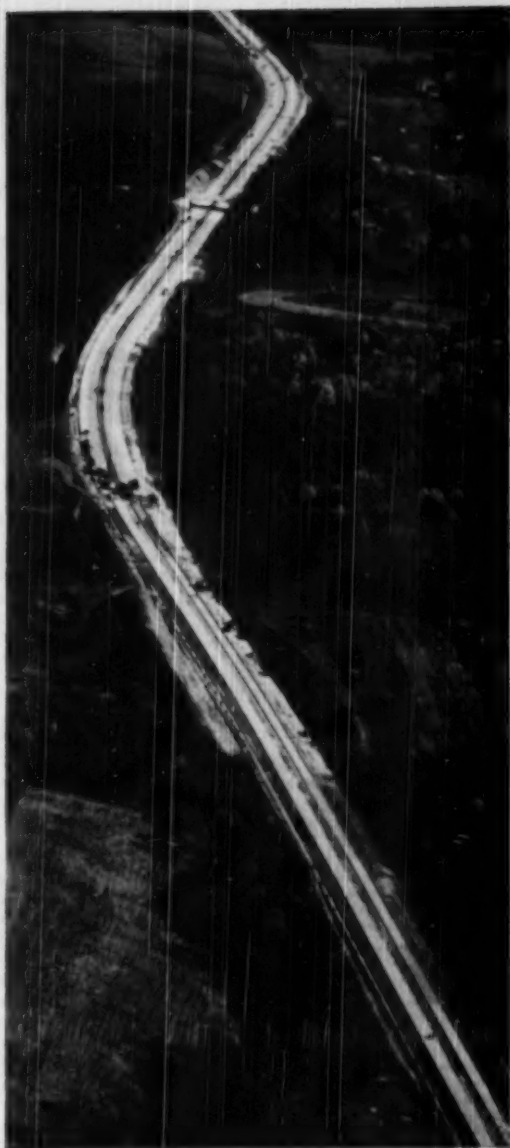
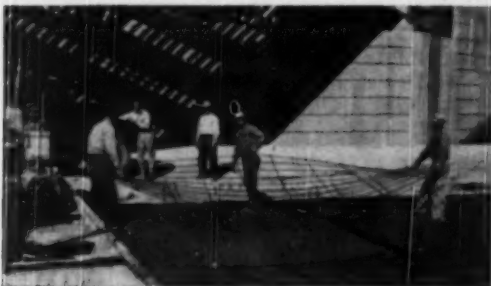


Large Bethlehem-built girder, one of many steel girders used in constructing new Turnpike bridges, being inched into place by heavy crane.



Bethlehem Dowel Unit, designed to minimize load-transfer problems by permitting free movement of dowels in slab, about to be covered with concrete.

Workmen carry Bethlehem Hinged Bar Mat into place after first pour. Mat folds over double, installs fast. Completed lanes shown in background.



Airview showing construction activity on 100-mile eastern extension of the Pennsylvania Turnpike, at a point approximately due south of Lebanon, Pa.

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation. Export Distributors: Bethlehem Steel Export Corporation

STEEL FOR HIGHWAYS

Dowel Units • Reinforcing Bars • Bar Mats • Guard Rail
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ROADS AND STREETS

September, 1950 • Vol. 93 • No. 9

Roads and Streets represents 58 years of continuous publishing in the highway field; combined with Engineering & Contracting and Good Roads Magazines, established in 1892

E. S. GILLETTE, Publisher



HALBERT P. GILLETTE, Editor-in-Chief

In This Issue

Coming Articles

Report on the New Jersey Turnpike

How man-made problems have complicated the all-out push to complete this unprecedented \$220,000,000 project by late 1951, is detailed in a full-scale project review by Col. V. J. Brown.

Million Yards per Mile

How would you go about designing, constructing and conducting field control tests and inspection, on a slide-infested project involving excavating 1,200,000 cu. yd. for a 3.1-mile mountainside location? West End Bypass Road in Pittsburgh. Special R & S staff report coming.

Repping for Very Severe Conditions

The old concrete pavement was fragmented and a new concrete base and hot-mix asphalt topping placed on US 41 (Milwaukee to Chicago).

Hard Facing—the Contractor's Friend

Methods recommended for various familiar armoring applications will be reviewed, with diagrams and pit-guide to shop foreman and construction welders.

Also Due Soon:

Articles on . . . Rapid stability test for hot-mix asphaltic concrete . . . How American equipment and know-how was capitalised on a Near-East airport . . . Ice control and snow removal—several more timely reports . . . New quick field test for soil moisture . . . What the housing boom has done for city street departments . . . Emergency bridge reconstruction methods in Ohio . . . Contractor methods stories covering earthmoving, rock jobs, bridges—watch for articles on outstanding 1950 jobs.

Contractors and the superintendents . . . officials and engineers . . . something for all in each issue of "Roads and Streets". Watch for your next copy. Practical "how it was done" articles invited from readers.

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A magazine devoted to the design, construction, maintenance and operation of highways, streets, bridges, bridge foundations and grade separations, and to the construction and maintenance of airports.

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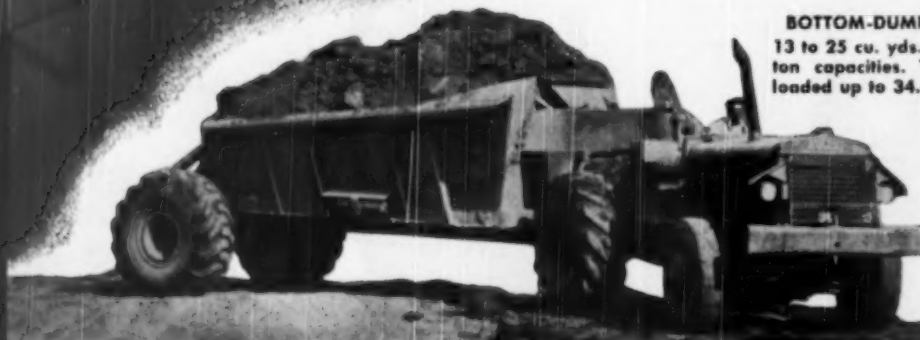
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Payload capacities range from 10 to 34 tons. Top speeds with full payload up to 35.7 m.p.h.

The record proves that Euclids have the rugged strength and stamina to perform profitably year after year in heavy off-the-highway service.

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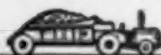


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ALL-NYLON tire record: no blowouts, no bruise breaks, no flex breaks!

THE B. F. Goodrich ALL-NYLON tire is proving successful on construction projects all over the country. The record speaks for itself—up to now no blowouts, no bruise breaks, no flex breaks! And that includes severe operating conditions on jobs where flex and bruise failures formerly were common.

Along with nylon, BFG uses weltless construction; no cross-threads in tire plies to hamper cord action and allow some cords to stretch out. Therefore, tire growth is reduced—tires last longer.

Nylon tires always provide big sav-

ings on construction projects, in quarry and other operations where heavy loads and rough terrain have made tire costs high.

The new, all-nylon construction is typical of the continuous improvements being made in tires by B. F. Goodrich. Long ago, BFG engineers developed special types of tires for construction and other off-the-road service. For more information on the way B. F. Goodrich tires can do more work and save you money, call your BFG dealer—or write directly to The B. F. Goodrich Company, Akron, Ohio.



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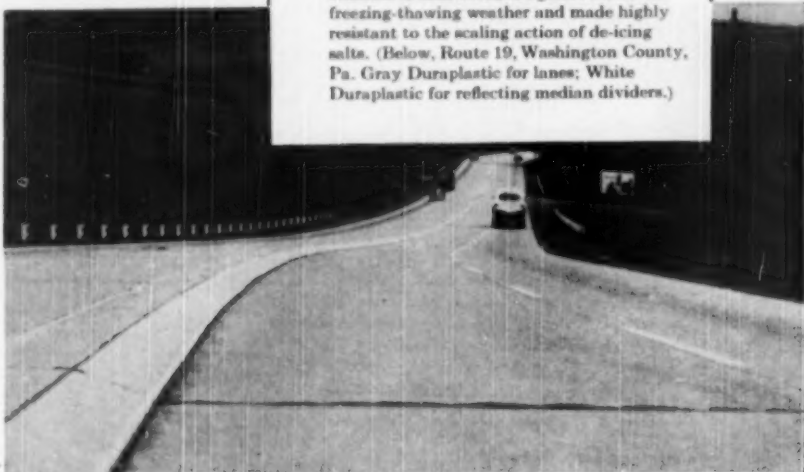


Better for paving work

Duraplastic air-entraining portland cement requires less mixing water for a given slump, makes concrete more workable, more plastic, more cohesive, more uniform. The mix dumps, spreads, screeds and finishes easily; allows finishing closer to paver, earlier protection for curing.

Makes more durable concrete

Duraplastic air-entrained concrete minimizes bleeding and segregation. Finished concrete is thus fortified against effects of freezing-thawing weather and made highly resistant to the scaling action of de-icing salts. (Below, Route 19, Washington County, Pa. Gray Duraplastic for lanes; White Duraplastic for reflecting median dividers.)



YET DURAPLASTIC* COSTS NO MORE

It sells at the same price as regular cement and requires no unusual changes in procedure. Complies with ASTM and Federal specifications. For descriptive booklet, write Universal Atlas Cement Company (United States Steel Corporation Subsidiary), 100 Park Avenue, New York 17, N. Y.

OFFICES: Albany, Birmingham, Boston, Chicago, Dayton, Kansas City, Minneapolis, New York, Philadelphia, Pittsburgh, St. Louis, Waco.

*"Duraplastic" is the registered trade mark of the air-entraining portland cement manufactured by Universal Atlas Cement Company.

ATLAS

DURAPLASTIC

AIR-ENTRAINING PORTLAND CEMENT

Makes Better Concrete at No Extra Cost

"THE THEATRE GUILD ON THE AIR"—Sponsored by U. S. Steel Subsidiaries—Sunday Evenings—NBC Network

As a crane the Link-Belt Speeder is beautiful to operate . . . As a shovel it is a brute for production

listen to me:



LINK-BELT SPEEDER

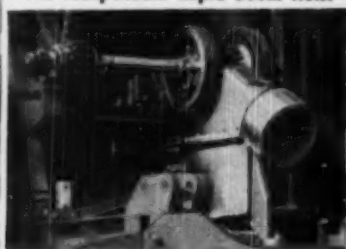


Don't take my word for it, — I only get reports from operators, like Fred Scanlan of Welso Construction Co., Chicago. Fred has been operating Shovel-Cranes for 35 years. His latest job is pouring concrete on two seven-story housing buildings. He is using a K-365 with 90' boom, 20' jib and 1½ yard bucket. But let him tell it: "This K-365 is the easiest machine I ever operated. The Independent Rapid Boom Hoist is the ticket for this type of work. And there's nothing like the K-365 for moving in close quarters. Handling concrete requires careful and close spotting: this is easy with Speed-o-Matic controls. And with all this I can reverse the machinery with a load."

That's a kind testimonial, Fred, and we thank you. There are other advanced engineering features of the K-360 and K-365 Shovel-Cranes that make these machines outstanding in their class. Ask your Link-Belt Speeder distributor about them.



The Independent Rapid Boom Hoist



(Optional Equipment) This is a "Safety-type" independent friction clutch operated rapid boom hoist, power controlled both up and down. Worm gear is totally enclosed, running in oil, with automatic safety brake.

LINK-BELT SPEEDER



12,000

Only Adams

gives you this exclusive combination of advantages

- 1** 8 Overlapping Forward Speeds . . . Flexible working range speeds work—increases output—provides high transport speeds.
- 2** Wide Range of Blade Positions Without Mechanical Adjustments . . . Saves time in adapting machine to needed cuts.
- 3** Positive-Action Mechanical Controls . . . Dependable, accurate adjustments—because they're geared . . . Easy, natural steering.

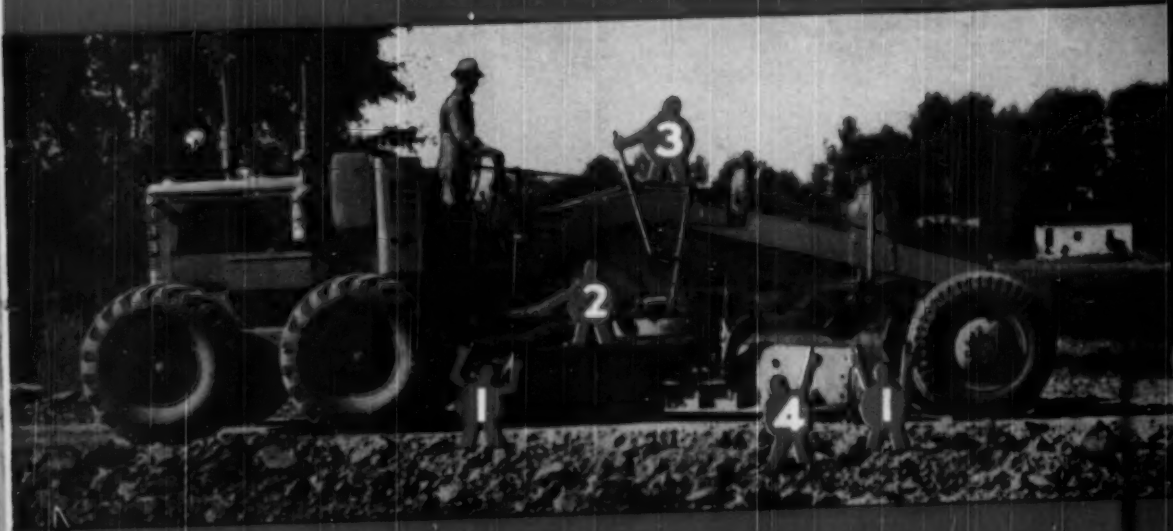
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AMPLE OPERATING CLEARANCES

- 5** Fast, Easy Servicing Plus World-Wide Dealer Service . . . Saves time and money.



Ample Operating Clearances

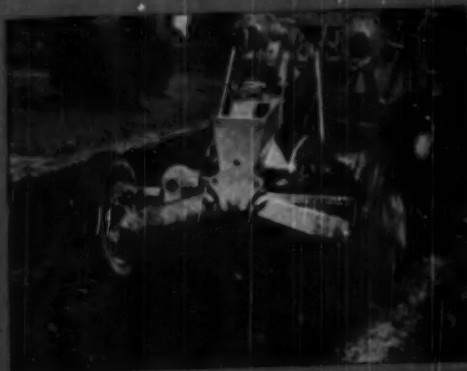


Quick, easy adaptation to work — Operator comfort, convenience, efficiency

Blade clearance—plenty of it, in the right place—is essential to fast, efficient blade positioning. That's why Adams Motor Graders are designed and built with an abundance of blade clearance at these critical points:

- ① **Between Blade Ends and Tires:** Lots of room here for sharp blade angles—without tire interference, front or rear.
- ② **Between Blade and Frame:** Plenty of space provided for free movement of the blade heel.
- ③ **Between Blade Assembly and Frame:** Adams arched frame permits higher blade lift—better clearances in cutting out of ditches and in grading over sharp-angle approaches to bridges and rail crossings.
- ④ **Between Blade and Scrapper Block:** Ample room for easy reversing of blade under scrapper block.

This important Adams feature means that all desired blade positions are obtained quickly, easily—one of the many reasons why Adams Motor Graders are the fastest, smoothest, most accurate and efficient on the market. See your local Adams dealer.



Adams high-arch front end provides plenty of clearance for straddling large windows. Bulldozing of walls through material is eliminated—no waste of power, no loss of operating speed.

J. B. ADAMS MANUFACTURING CO. • WINDHAM, ILLINOIS

*Make your next
motor grader an*

Adams



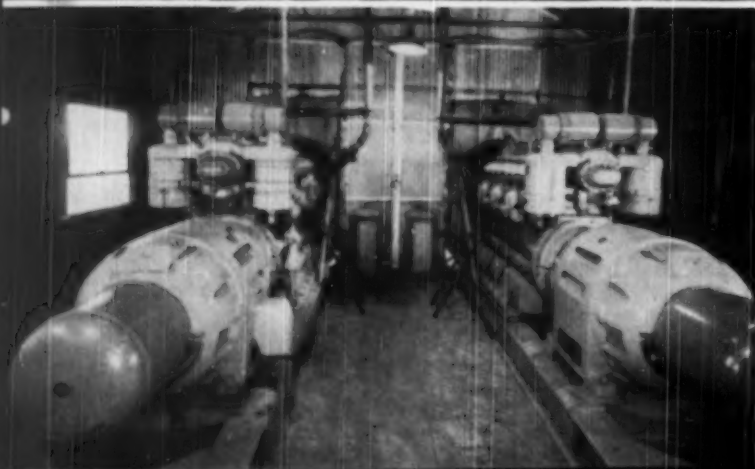
◀ A D386 "Cat" Engine powers this Maniotowoc dragline, with 6-yd. bucket and 120-ft. boom, building levee on Galveston Bay. Owned by McGinnes Bros. Construction Co., Houston, Texas.

"Cat" Engines

BUILT



◀ This crushing plant, owned by Arthur R. Alvis, Butler, Mo., has a "Caterpillar" D375 Engine driving a Universal pulveriser. Capacity, 125 tons of road rock per hour.



◀ Two "Cat" D397 Electric Sets, each with capacity of 316 kw., furnish light and power for Cedar Bluff Dam construction job. Contractors, Lytle-Amis & San Orr, Ellis, Kans.

BACK of the high preference for "Caterpillar" power on construction jobs is a long experience of profitable operation.

Construction men know they can depend on steady, day-in-day-out performance from "Cat" Engines and Electric Sets. And they know they'll get 24-hour service—anywhere—from "Caterpillar" dealers.

The right power for every type of job is now available in the complete "Caterpillar" line. There are ten Engines, ranging in size up to 500 hp. (maximum), and ten Electric Sets, up to 314 kw. (12-hour duty).

Over 150 manufacturers make "Cat" Engines available as power for their equipment. They know that quality power adds to the performance of their product—gives greater satisfaction to the user.

When you order new construction equipment, specify "Cat" Diesel power. Your "Caterpillar" dealer will be glad to show you how the big yellow machines will meet your requirements.

CATERPILLAR TRACTOR CO., PEORIA, ILLINOIS

FOR CONSTRUCTION MEN

LOOK UNDER THE HIDE

for the quality that pays off in performance!

The built-in quality of "Caterpillar" Diesel Engines doesn't show on the outside—but it shows up in performance. Just take a few examples of the hundreds of hidden quality features that give "Cat" Diesels their long life and dependability.



"Caterpillar" intake and exhaust valves are made of highly alloyed, heat-resistant steels. Their ample size and close machining and heat-treat specifications have resulted in thousands of hours of trouble-free valve operation. Valve and rocker arm design are made to reduce wear. Valves in the D397, D386, D375 and D364 Engines have special hard facings on contact surfaces, and have valve rotators and hardened valve seat inserts to reduce seat wear.



Fuel pumps are "Caterpillar"-designed and "Caterpillar"-built. Made of the cleanest high-chromium, high-carbon alloy steel obtainable, the pump plungers and barrels are diamond lapped. Pumps are heat treated to maximum hardness to give users thousands of hours of trouble-free, economical service. There is an individual pump for each cylinder. Pumps are free from adjustment and interchangeable.



The fuel injection valve offers owners maximum simplicity in design. Machined to extremely close limits, these valves are made from the finest quality materials—and are subjected to very detailed hardening processes. Valves are completely interchangeable and are adjustment-free. A large single orifice minimizes fouling. With the matched design of valves and precombustion chambers, owners use low-cost, non-premium fuels to get top economy.

CATERPILLAR

DIESEL ENGINES • TRACTORS • MOTOR GRADERS • EARTHMOVING EQUIPMENT

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SUCCESSFUL BIDDERS*

CHOOSE HD-19's for Major Projects...

Now The New Jersey Turnpike



EVEN FLOW OF POWER means smooth, fast loading. Torque converter automatically synchronizes speeds of the HD-19's pulling and pushing — work as one! Starts and stops are made through throttle — no constant clutching, no sudden shocks to operator and equipment on pusher contacts.

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Some of the reasons big, rugged HD-19's are preferred—

HYDRAULIC TORQUE CONVERTER DRIVE eliminates most gear-shifting . . . keeps tractor working at higher average speeds . . . provides smooth, cushioned performance. Increases production, cuts maintenance costs.

EASIER, FASTER SERVICING through simple unit assembly. Major units can be removed and repaired or replaced without removing unrelated parts. Simpler construction throughout.

**FOR GREATER PRODUCTION
FOR EASIER OPERATION
FOR SIMPLIFIED SERVICING**

SPEEDS BULLDOZING. Bigger loads are rolled faster . . . load, terrain and use of throttle govern forward speed — and there's no stalling of engine! High reverse gets HD-19 back for each pass quicker. No job is too tough to handle with its ground-gripping traction and heavy, correctly balanced weight.





Converter Tractors . . . Some Over 20 Units . . . are used by on this Outstanding 118-Mile, 40,000,000 cu. yd. Job

SIMPLIFIED MAINTENANCE AND LUBRICATION. All adjustments unusually accessible. All fittings or lubrication points readily reached — none under tractor. Extended lubrication periods—1,000 hours on truck wheels, track idlers and support rollers.

FULL OPERATOR COMFORT. With gear-shifting practically eliminated and hydraulic fingertip steering, operator's job is much easier — fatigue is cut, output goes up. Many other operating advantages.

RUGGED, DEPENDABLE. 40,000 lb. of properly balanced weight . . . long, wide, sure-gripping tracks — a powerful, heavy tractor that really "bears down" . . . outperforms and outlasts under any operating conditions.

* * *

On any job . . . big or small . . . tough or easy . . . you will cut costs, increase profits with powerful HD-19 Hydraulic Torque Converter Tractors. "Seeing is Believing." Ask your Allis-Chalmers dealer for a demonstration.

ALLIS-CHALMERS
TRACTOR DIVISION • MILWAUKEE 1, U. S. A.

*Originator
of the
Torque Converter
Tractor*

TOURNADOZER boosts averages 480 ft.



Tournadozer's 4-wheel drive on giant, 31.00 x 25, low-pressure tires put plenty of power and traction behind weighted blade to strip tough 2 to 4" asphalt from concrete.

Fast speeds both forward and reverse, together with constant-mesh "no-shift" transmission, increase output on shuttle-type operation. Tournadozer stripped up to 900 lineal feet on this Michigan State Highway resurfacing job.

A new, low-cost method

of removing blacktop from existing highways before resurfacing has been introduced to contractors by the Ann Arbor Construction Co. Working on U.S. 112 between Jonesville and Somerset for the Michigan State Highway Department, the contracting firm profitably used a high-speed, rubber-tired C Tournadozer to strip two miles of old, 2 to 4 inch blacktop pavement from a 20-ft. concrete roadbed. Material removed was mechanically sound bituminous concrete which showed no evidence of deterioration.

Faster than previous method

Prior to using the Tournadozer on this main Chicago to Detroit highway, Ann Arbor Construction Co. tried



* Tournadozer, Tournapulls, Tournarockers, Reg. U.S. Pat. Off.
© 1977 Tournadozer, Inc. Tournahoppers: Trademark 9187



TOURNAPULLS



TOURNAROCKERS



TOURNAHOPPERS

removal of BLACKTOP per day



Fast, rubber-tired speed and 100% mobility for Tournadozer travel over highway in job . . . work in heavy traffic . . . travel from one end of 20-mile Michigan road assignment to the other in little more than 40 hours.

removing the hard-packed asphalt by several conventional methods . . . including a backhoe with a grader blade attached to bucket. All proved too slow. The best day's production from any of these rigs was 100 lineal feet.

To boost this low output, Ann Arbor Construction Co. decided to try the power and mobility of a Tournadozer. They drove in a rubber-tired Tournadozer . . . put it to work on a section with grades ranging up to 15% . . . and, despite continuously heavy main-highway traffic and chilly temperatures, found that Tournadozer removed as much as 900 lineal feet of blacktop a day. It averaged 480 lineal ft. per day for the entire job! The total cost for the removal of the bituminous concrete surfacing, including loading and hauling away the refuse, and maintaining traffic

during the process, was under \$1.00 per lineal foot of highway or about .47 per sq. yd.

No mechanical trouble

Ann Arbor Construction Co. officials were pleased with the way Tournadozer performed under the steady high-speed pounding required to tear up the tough asphalt. They report no mechanical trouble since they have used the machine.

Check for yourself

Check into this profit-making C Tournadozer for yourself. It's a moneymaker wherever it goes . . . whether you use it for dozing, pulling or push-loading. Call your LeTourneau Distributor or write for the complete story . . . NOW.

LETOURNEAU



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IT'S RUBBER THAT PUTS THE ACTION IN TRACTION

"hard-hats" know



TRU-LAY
TAKES THE
TOUGHEST
JOBS IN
STRIDE

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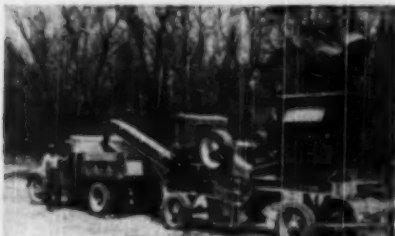
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UNIVERSAL "TRAVELER"

CRUSHING, SCREENING AND LOADING PLANTS



CS-TRAVELER—Screens out finished pit run, crushes oversize. Mixes and loads. Available in 916, 1016, 1020 or 1024 sizes with bronze or roller bearing jaw crushers.



TS-TRAVELER—Screens finished pit run, crushes oversize. Blends and loads. Available in 916, 1016, 1020 or 1024 sizes with bronze or roller bearing jaw crushers.



CSE-TRAVELER—Closed circuit plant with bucket elevator return from crusher to screen. Produces specification material. Available in 916, 1016, 1020 or 1024 sizes with bronze or roller bearing jaw crushers.

Enjoy rock bottom aggregate costs where production requirements are moderate. Here are three low priced units from the complete line of famous Universal crushing plants. You get advanced engineering design for top efficiency and economy. Simplicity of construction provides easy operation with minimum man-power. The sturdy Universal overhead eccentric jaw crusher with its double crushing action and force discharge of material gives you greater crushing capacity.

Designed for "crush-and-travel" operations, Universal TRAVELER plants are ideal for building access roads to backwoods locations, as well as logging and oil field operations. Also for secondary road construction and maintenance work.



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START AS LOW AS

\$8632.00

F.O.B. Factory—Complete with Power

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**Save Time
with the
DIRECT POUR!**

THE OLD
time-wasting
crane method

THE NEW
cost-cutting MultiFoote
with HighLift Boom

FIGURING on pouring bridge piers, abutment, walls or retaining walls? No matter what it is the MultiFoote with HighLift Boom can save you money with the Direct Pour.

The MultiFoote can handle a wall form with almost the snap and click of a road pouring job. It brings you the capacity and output of a paver and it is the only paver that can put this output up 23 ft. or above. It gives you better control of the mix, saves the time always wasted in transferring the mix from one

machine to another and frees the crane for other work. Your MultiFoote on wall pouring will eliminate false work and save time and money.

If you have a pouring job to do, check into the MultiFoote and the HighLift Boom. Let us tell you what others are doing with it. There is a MultiFoote Sales Representative near you.

THE FOOTE COMPANY, INC.

Subsidiary of Blaw-Knox Co.
1936 State Street • Nunda, New York

MULTIFOOTE PAVER
FOR EVERY PLACE CONCRETE MUST BE POURED



Do you lay Black Top? The Adnun is an all 'round Black Top and Material Spreader. One machine for black top, stone, slag, cinder, sand or soil cement. Does the job with less cost for subgrade preparation—Ask for details.

A product of The Foote Company, Inc., Nunda, N.Y.

ADNUN BLACK TOP PAVER

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HYSTER TRACTOR TOOLS

Any one of them makes your
"Caterpillar" Diesel Tractor
do double duty

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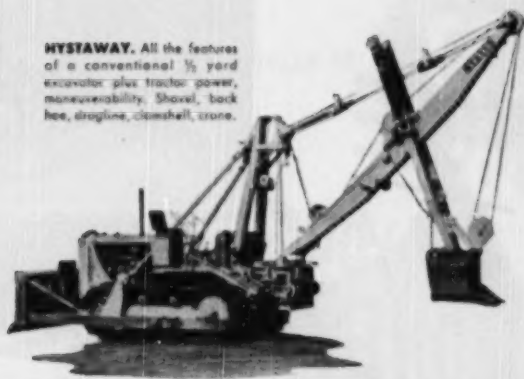
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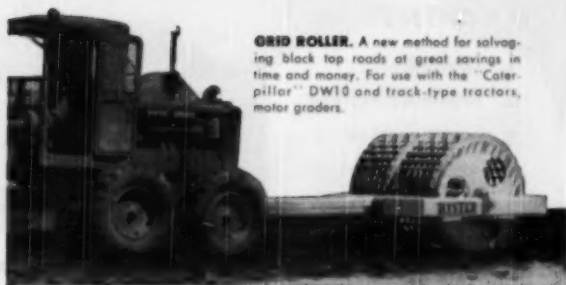
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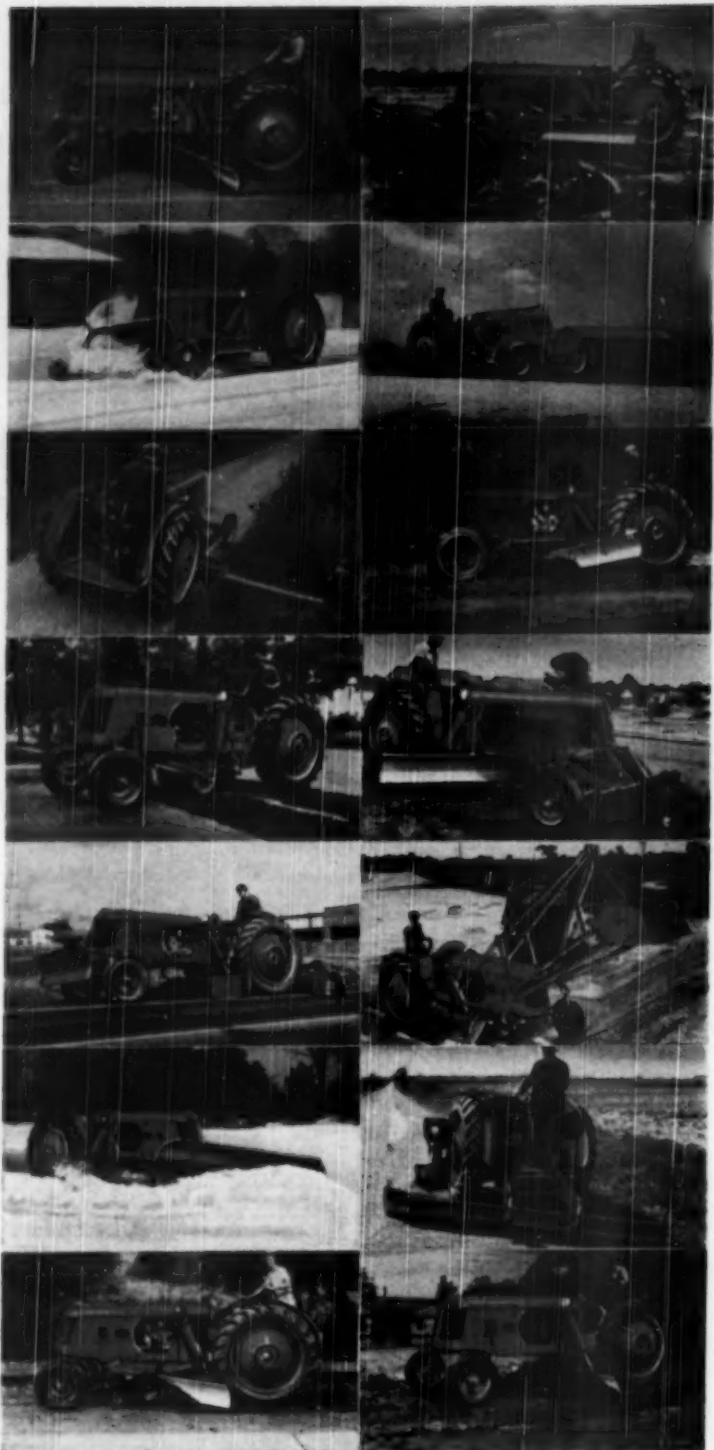
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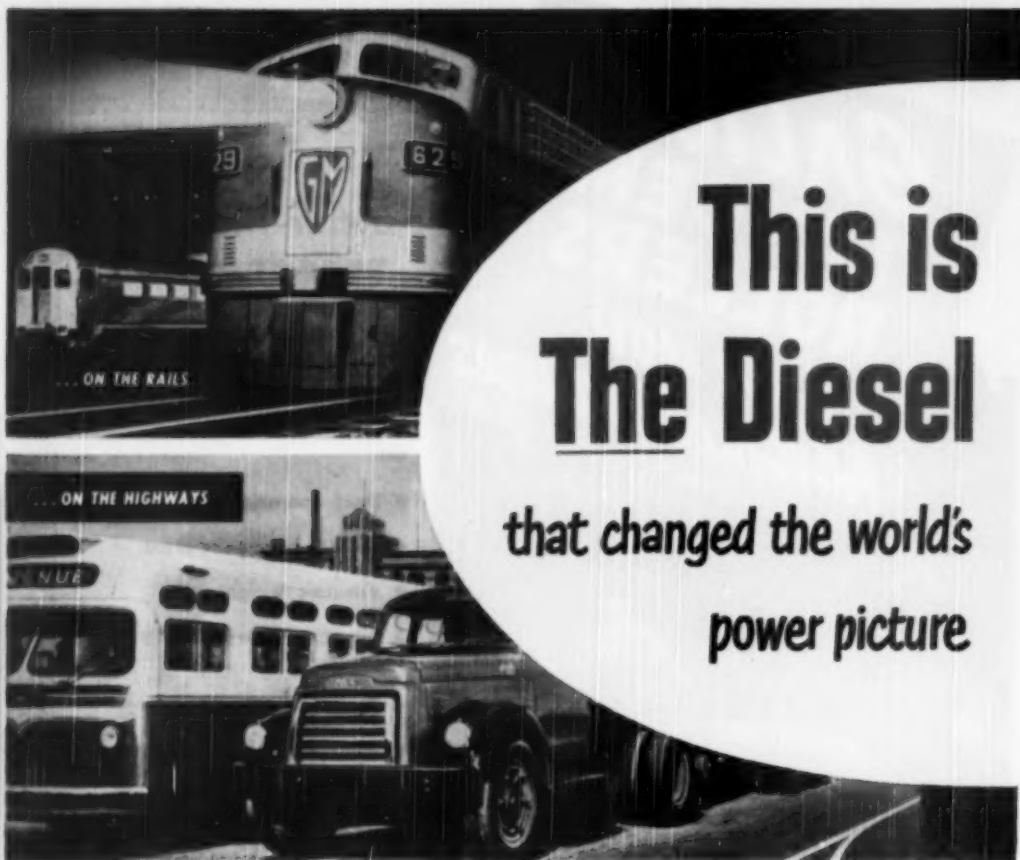
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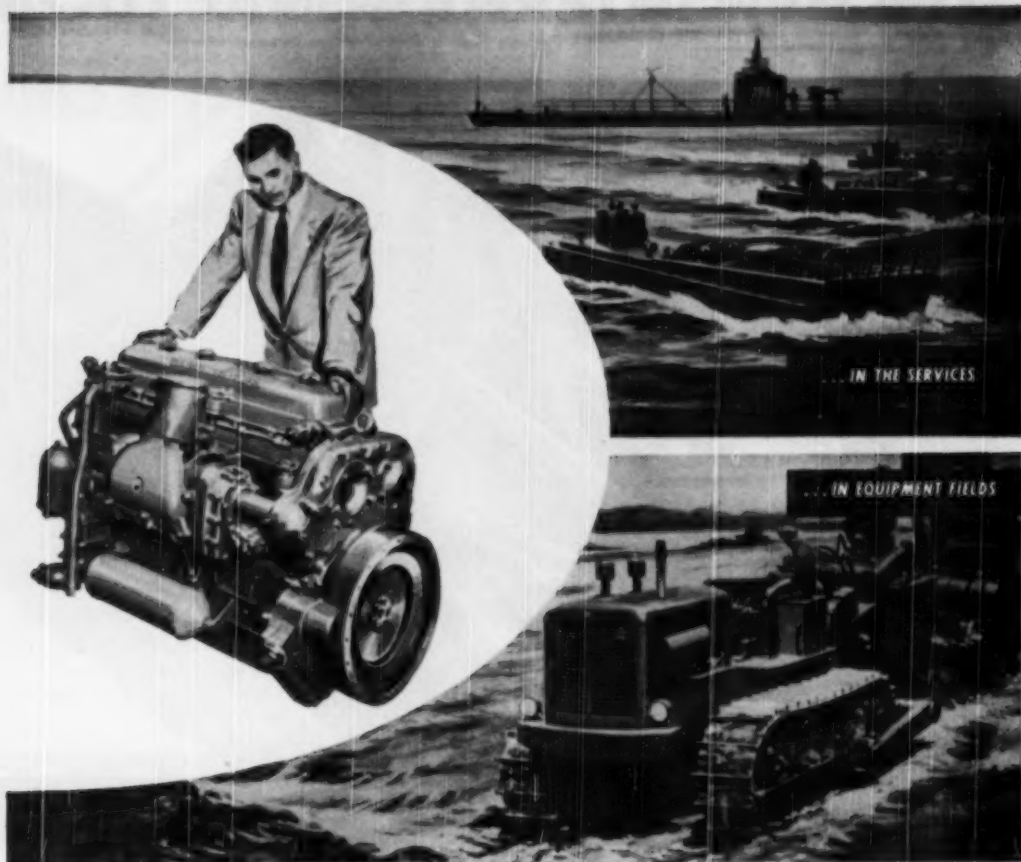
It is the General Motors Diesel engine, one size of which now drives most of America's crack passenger and freight trains. Another powers many of the Navy's submarines and other vessels.


And a third—the GM Series 71 engine—is the most widely used of all, totaling 46,000,000 horsepower. It has surmounted the exacting conditions of War and met the economic requirements of Peace. It has brought the same efficiency to a wide range of jobs, including many where Diesel power was never usable before.

That is because the "71," like all GM Diesels, is a two-cycle engine. Two-cycle means it produces power with every piston downstroke—in contrast to most other Diesels that generate power only on every second downstroke.

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These basic differences make GM Diesels far more compact and much lighter than other Diesels of equal horsepower—without sacrificing ruggedness. These engines accelerate faster, are unmatched for smoothness, start quickly and are clean-burning.



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Today, GM Series 71 Diesel engines are taking the place of gasoline engines on many types of power jobs — of steam engines on land and sea — even of other Diesels because twelve years' experience has proved they are so dependable, so efficient, so economical.

General Motors 2-cycle Series 71 engines provide Diesel power at its best — *Diesel brawn without the bulk.*

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The New INTERNATIONAL TD-24



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Separate reverse lever for quick change of direction. The tractor moves in the direction the lever is moved.



Self load and run with scrapers of 17-yard capacity—and shift gears on-the-go with the rolling load.



Cut waste shifting time out of work cycles; provide the best speed for every operation, 8 speeds in each direction!



INTERNATIONAL



CHAMPION of Crawlers

"The TD-24's work right along on slopes so steep we have to cut them down before other tractors can climb them even without loads," says Bob Rardin of Rardin Brothers, Akron, Ohio. "They are fast tractors, easy to shift and have plenty of power. This combination really moves dirt." His TD-24 was equipped with a bulldozer.

"It will out-buck any tractor I've ever run," says Harold Wooley's operator, Drain, Oregon, "and sure push dirt up hill—and climb steep grades." His TD-24 works regularly on 30% to 50% grades, building mountain roads.

"I wouldn't have anything else," says another Oregon operator. He works for V. R. Russell &

Sons of Valsetz. "It's sure fine on bulldozing; best dirt mover I ever got hold of."

That's the way owners and operators talk about the International TD-24 Crawler. It has earned their praise, for it does everything any other big tractor can do, *plus many things that NO other tractor can do.* The TD-24's versatility makes it the most useful and profitable earth-mover in any equipment line-up.

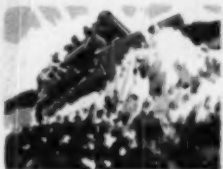
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Instant speed change up or down one speed, or stop, without declutching. Planet Power drive does it!



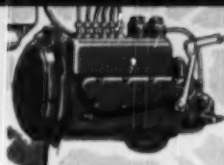
Work on grades up to 100%. Its power, ground contact, balance and lubrication are right for tacking any grade.



Planet Power steering puts turns with power on both tracks, feathered turns and pivot turns at your fingertips.



Handle heaviest loads on gradual turns as easily as straightaway because both tracks are powered in the turn!



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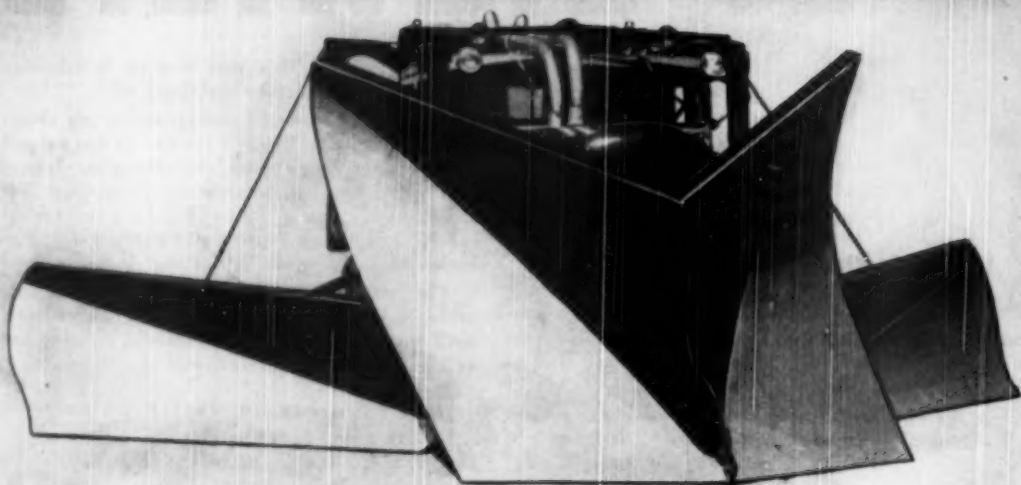
Push or pull through tough going. The engine delivers extra "power" when its r.p.m. is pulled down by load.

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Many Models to meet ANY SNOW and ICE Conditions



25 HP. WALTER SNOW FIGHTER. Simple, most powerful and effective snowplow and scraper. 12,000-G.V.W., with Vee Flare and Right and Left 16-foot speed wings. Right-flaring width 28 feet, widening width 14 feet. Cuts great depths and banks of snow at high speeds. Ideal for snow highways and airports. Equipped with dump body.



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This famous drive system, incorporating automatic lock and torque proportioning differentials, plus suspended double reduction drive, translates every ounce of engine power into positive driving action in four wheels at all times. Result—no wheel-spinning, side-slipping or stalling in deep snow and on slippery surfaces and grades.



125 HP. WALTER SNOW FIGHTER. Widely used for moderate snow conditions where a smaller, but fast, handy and powerful unit is required. Usually equipped with one way plow and right wing for widening. Also may be equipped with center scraper blade, offset V or V head plow. Has dump body for general hauling.

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Have you adequate *modern, heavy-duty* snow fighting equipment to cope with a severe winter? Don't take chances with obsolete, slow-moving or makeshift equipment. Place your order for Walter Snow Fighters **NOW**, to assure earlier delivery—to assure clear roads no matter how tough the weather. Here are a few outstanding advantages:

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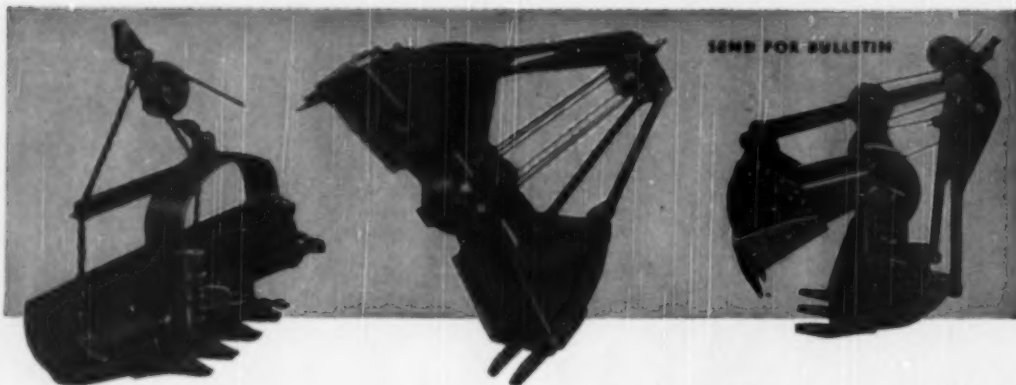
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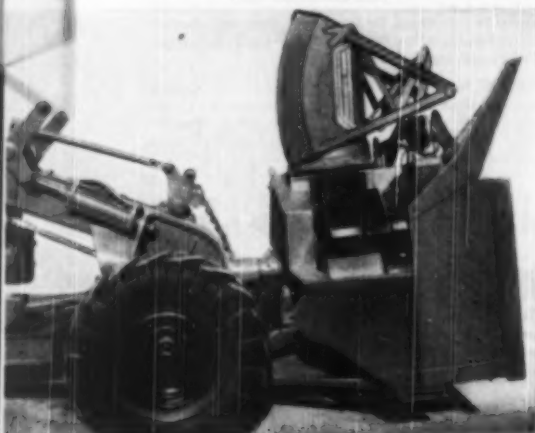
Austin-Western
SICARD



Engine, radiator, clutch and batteries for the Snow Master are mounted beneath the arch of the grader frame, and can be quickly and easily removed as a unit.

AUSTIN-WESTERN

All-Wheel Drive and Steer Power Grader with SICARD Snow Master Rotary Snow Plow



Close-up of Sicard Snow Master in raised position, with blower housing revolved for casting to the right. The Sicard unit can be quickly removed from the front end of the grader.

Wherever there's a tough problem—freeing country roads from a smothering blanket of snow, loading trucks to capacity in crowded business districts, or cleaning streets right to the curb in closely built residential areas—this outfit has what it takes. Sicard Snow Master, with its powerful blower and exclusive patented "wrist action" chute for precision casting, backed by the power and drive of the Austin-Western Power Grader, with its exclusive All-Wheel Drive for maximum traction and *front end* control, and exclusive All-Wheel Steer for maximum maneuverability and *rear end* control.

This is no *single season, single purpose* unit! The grader that drives the Sicard is the same Austin-Western machine that dominates the *grader* field 365 days a year on every type of work. Thus, there is no closed season for the outfit. Spring, summer and fall it's the last word in graders ... when winter rolls around, it is ready in a few hours for the job of snow removal.

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BLOCKADE!



Cutting through heavy, icy drifts in the Colorado "Rockies."



Power and steering control at all four wheels holds the grader steadily to its work in widening.

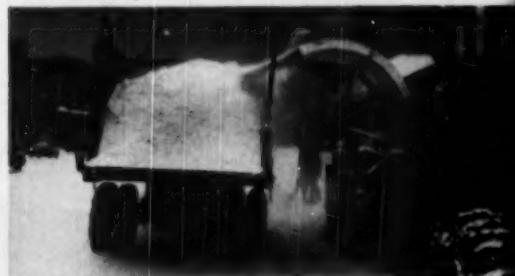
EXCLUSIVE FEATURES Set New Performance Standards

The powerful rotary augers of the Sicard grind up compacted snow and ice, whirling it toward the throat of the blower. The exclusive, saw-tooth cutting table, separating the two sets of augers, prevents the snow cut by the upper augers from falling and choking the lower series. There's no bottleneck at the front end of the Sicard... each auger does its share of the work. Ice cutters can be quickly attached to the augers, when exceptionally difficult conditions are encountered.

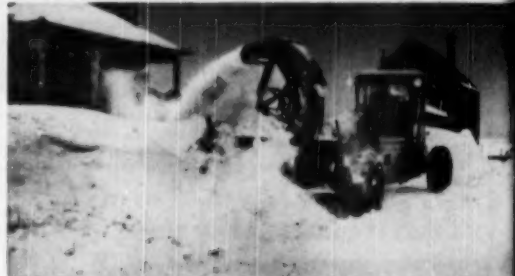
The blower of the Snow Master has a casting range of up to 150 feet on either side, *plus* the exclusive, patented "wrist action" casting chute which is completely controllable.

All-Wheel Drive provides the *front end* control which has been found so important on truck-mounted rotary plows. All-Wheel Steer provides—for the first time on any rotary—the short turning radius which is always advantageous, and the *rear end* control which is the only thing that will successfully resist the side draft that is always present when widening out.

Austin-Western and Snow Master—this is the combination to break the clutch of winter—to keep city streets and country highways clear for the rolling wheels of commerce.



Complete directional control, with "wrist action" chute, makes it easy to load trucks from any angle.

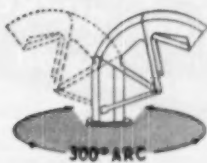


The rotatable, telescopic chute puts the snow precisely where it's wanted. No broken windows... no clogged driveways.

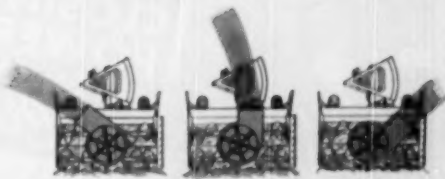
EFFORTLESS HYDRAULIC POWER MAKES ALL ADJUSTMENTS... INSTANTLY



Controls telescopic chute for long or short range casting.



Rotates chute in 300° arc for casting or loading to either side.



Rotates blower housing for direct casting to either side, or through chute.

PHILADELPHIA 1939
Austin Western
SINCE 1889

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Here's Why . . . Any experienced snow plow operator will tell you that Frink Plows push easier.

Frink Sno-Plows are engineered to keep snow moving faster. The cutting edge and the front of the moldboard are built with just enough shear to keep snow moving at all times without producing a side thrust.

Because they push easier Frink Sno-Plows require less power. This is one reason they cost less to operate.

Frink Sno-Plows also save tires; save axle repairs because there is less "unsprung weight". A nose lift chain and two heel adjusting chains carry the entire weight of the plow above the truck springs while going from one job to another.

For further information Write Box R505



WILL NOT WEDGE . . .

Frink Sno-Plows are noted for the fact that they will not wedge or stick no matter how damp the snow or how hard they hit.

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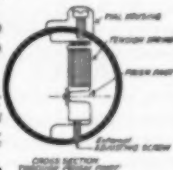


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THAT DOES THREE JOBS

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SCHRAMM
Pneumatractor

you can use the



SCHRAMM
Pneumajack

OR



SCHRAMM
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OR



SCHRAMM
Pneumatamps

Merely by a quick, easy interchange of these three Schramm tools —paving breaker, rock drill or two backfill tampers—and your Schramm *Pneumatractor* will perform three jobs! How is it done?

The tools are mounted at rear of *Pneumatractor*, with air power feed and return. And each tool has an adaptor that fits on the piston rod of the pneumatic cylinder.

SPECIFIC USES:

Pneumajack. D-55 or D-45 Schramm Rock Drill powerfully drills holes in pavement for mud jacking, setting parking meters, production drilling in quarries, grouting, etc.

Pneumabreaker. (B-80, B-60 or B-35) Schramm Paving breaker with wide chisel for breaking macadam, with real point or narrow chisel for breaking concrete, with special adaptor for driving posts for line or snow fences, etc.

Pneumatamps. Two BT-32 Schramm Backfill tampers can be mounted for multiple tamping in ditches and trenches.

Schramm's Pneumatool is most profitable to use. For complete details and advantages, write for Bulletin PPJ-50.

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By H. W. Benedict

Assistant Highway Engineer,
California Division of Highways

NOTEWORTHY field procedures were used on a resurfacing project in Mendocino County, California, last year. The project consisted of 8.3 miles of U.S. 101. [As reported in May-June, 1950, California Highways and Public Works.] An old bituminous surface had broken up and was a serious maintenance problem. A contract awarded to Clements & Company, contractors, provided for cement treatment of existing and imported materials by road-mix methods, then applying 3 in. thickness of bituminous plant mix.

While all phases of the work were completed in a commendable manner by the contractor, that of road-mixed cement-treated base is especially worthy of comment; both for the efficient way in which the work was handled and for the final appearance of the work, which was excellent. Following is a brief resume of the methods used by the contractor to accomplish these results.

Heavy Scarifying Job

Scarifying of the existing and imported base material consisted of breaking, to the size of the largest particle in the aggregate, all that material to be cement treated. Existing material ranged from armor coat to exceedingly hard road-mixed surfacing, to which was added varying quantities of imported base, placed under the same contract. This latter consisted of crushed river gravel. At several locations the imported base material comprised the entire thickness to be cement treated. Generally, however, it was combined with por-

tions of the existing base to make the total thickness.

The prime tool for scarifying was built by the contractor after several years of experimentation. It consisted of the frame, wheels, etc., of a Le Tourneau ripper to which were welded eleven shanks from a Caterpillar No. 12 motor patrol ripper. These shanks were fitted with standard scarifier teeth. The unit was towed by a D8 Caterpillar, and proved very effective in ripping up the hardest bituminous pavement encountered on this contract. To further pulverize the larger pieces of ripped-up oil cake, a Caterpillar tractor was walked over the scarified base, utilizing the grinding action of the growlers with good success. A motor grader was also used in this operation to turn the scarified material for the above equipment and to reshape and re-lay the material after scarifying. This grader was also used to prepare the windrow ahead of the road-mixer.

Spacing Out. The contractor made one miscalculation in that he did not

begin his scarifying operations further in advance of mixing operations. Consequently, he was forced to work the scarifying equipment overtime to keep ahead of the mixer. In this connection, it is also believed the State is better served when the operations are well spread out, since it provides two short areas of controlled traffic rather than one long traffic control with the resultant longer delays for traffic.

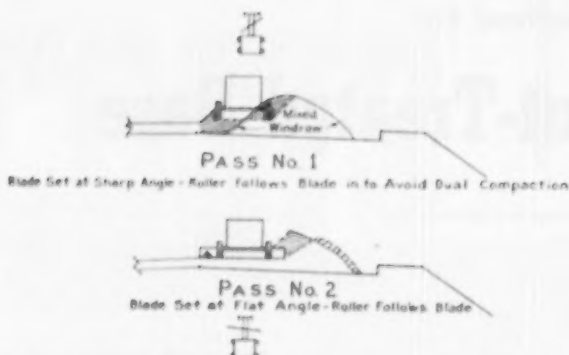
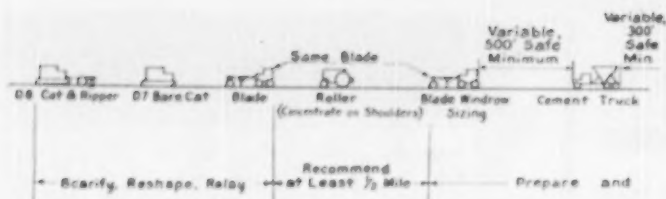
How Cement Added

Handling Cement. Four percent of cement was added to the material to be road-mixed directly ahead of the mixer by means of a gondola truck built by the contractor. This cement spreader consisted of a three-axle drive truck on which was mounted a metal bin in the shape of an inverted pyramid. This bin held two cans (10 tons) of cement, and was loaded at a central storage area by a dragline which also served to unload the cement cans from transport trucks.

Cement was distributed on the windrow by an ingenious rotary valve mounted at the outlet of the cement bin. Quantities of cement could be very closely controlled by means of



★ The contractor's train in operation—see accompanying diagrams.



★ Diagrammatic sketch showing types of equipment, arrangement, and spacing, and method of laying out road-mixed cement treated base.

simple gear changes on the chain drive of the rotary gear. This proved to be an economical and highly satisfactory method of adding cement.

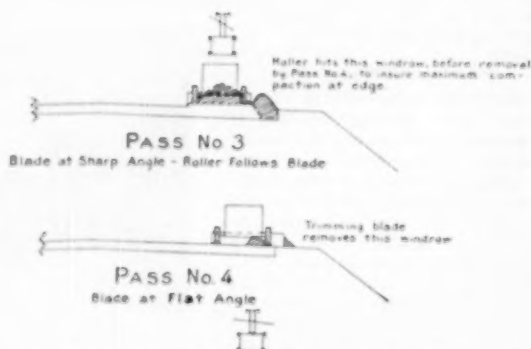
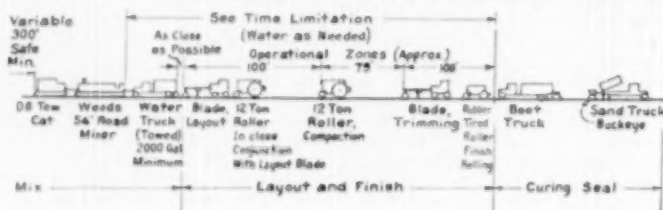
Mixing of the prepared base was done with a Woods 54-in. road-mixer, towed by a D8 Caterpillar tractor equipped with a special transmission and power take-off so integrated as to provide a forward movement of about 20 ft. per min. with the mixer fully loaded.

The machine mixed one traffic lane at a time, in this case a section 12 ft. wide. In some cases the compacted depth was five inches and in others it was six inches. It readily mixed the heaviest windrow which consisted of approximately 7.2 cu. ft. of uncompacted aggregate per lin. ft. The machine was stalled on only two locations where the windrow had been poorly sized and contained approximately 9 cu. ft. of uncompacted material.

Water Distribution

Water was furnished the mixer by means of a water truck towed directly behind the mixer by a quickly detachable tow bar. The water was pumped from the truck through a meter to spray bars within the mixing drum. The quantity of water added to the mixer was controlled by tables prepared by the engineer integrating the rate of flow with the speed of the machine, the size of the windrow, and the moisture content thereof. After some experience with the machine, moisture content could be determined very

closely by feel and touch. Laboratory tests showed this method to be very reliable; it being the first job in the writer's experience when it was not necessary to remove over-watered "quakey" spots in the finished base.



★ Continuation of above diagram, showing latter part of equipment train and details of passes 3 and 4.

Spreading. After poor results were obtained in an attempt to use a home-made self-propelled spreading device to lay out the mixed base material, the contractor elected to use a motor grader to spread the windrowed cement treated base. This method proved economical and produced a true section under the conditions encountered on this contract. It was immediately obvious that the entire progress of the work depended upon the skill and ability of the individual operating this grader, since the travel of the mixer could not exceed the spreading of the processed material. The contractor was fortunate in having an extremely capable operator who managed to handle the material as fast as it was mixed and yet complete the process in a manner acceptable to the inspectors.

To facilitate the above, the superintendent and engineer realized that an orderly method of spreading should be devised. Accordingly, a method was developed which both satisfied the specifications and allowed for the rapid completion of the operation. This method of laying out the material is best described by the diagrams shown.

Compaction was obtained with two 12-ton three-wheeled rollers. The first worked in close conjunction with the spreading grader; the second completed the initial rolling. The material was then trimmed by another motor grader, after which the base was given

the final rolling with a contractor-constructed rubber-tired roller, conforming to specifications for this type machine.

Sealing of the completed base was accomplished in the usual manner, the contractor using a 1,300-gal. boot truck to spread the asphaltic emulsion, and a Buckeye spreader to distribute the sand.

However, this operation differed in some respects from the usual in that the contractor stockpiled sand for the curing seal at various locations on the job. This procedure obviated the usual costly delay while the sand truck was returning to the plant for sand.

Much Time Saved

As a result of the above well-planned and well-coordinated operations, and the selection of adequate machines and skilled operators, the contractor was able to complete the cement treated base and related items of work in a length of time far shorter than that previously experienced in this district.

Project Statistics

Following, in outline form, are the more important statistics on this phase of the contract:

Total square yards CTB mixed	118,316 sq. yds.
Equivalent tons CTB mixed (at 140 lbs./cu. ft.)	32,120 tons
Working days to complete CTB	12.5 days
Working hours to complete CTB	160 hours
Average tons CTB mixed per day	2,570 tons
Average tons CTB mixed per hour	216 tons
Maximum tons CTB mixed per day (approximate)	3,100 tons
Rate of travel of Woods mixer, average	18.7 ft./min.
Rate of travel of Woods mixer, maximum	20.9 ft./min.
7-day test specimens—	
High	1,400 lbs./sq. in.
Low	680 lbs./sq. in.
Average	1,054 lbs./sq. in.
28-day test specimens—	
High	1,770 lbs./sq. in.
Low	745 lbs./sq. in.
Average	1,211 lbs./sq. in.

Contractor Clements & Company was represented on the contract by Superintendent J. R. Paselk; the State by Resident Engineer H. W. Benedict, assisted by R. J. Datel on tests and Jack R. Rowe, street inspector.

Penn. Turnpike Installing Modern Radio System

THE entire Pennsylvania Turnpike, extending 327 miles across the state, will be equipped with the world's most modern radio communication system, according to T. J. Evans, Chairman of the turnpike commission. Incorporating technical features as advanced and modern as the turnpike itself, this system will provide the ultimate in communications for the safety and convenience of the motoring public.

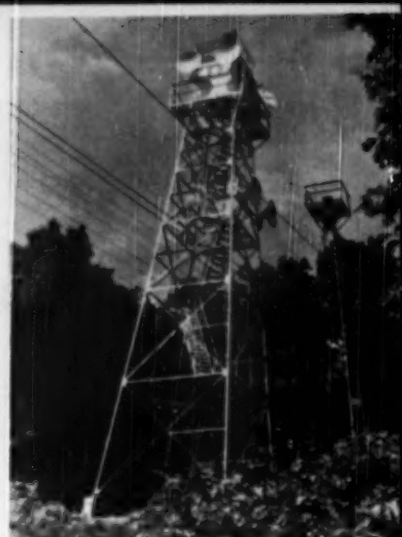
Interchanges, maintenance buildings, tunnel portal buildings, police headquarters, maintenance headquarters, the Harrisburg Turnpike office, patrol vehicles, and emergency trucks will be equipped with two-way radio for complete coverage of the Turnpike. To provide for maximum efficiency of operation the radio system will be divided at Everett, Pa., into two sections. Simultaneous conversations may be carried on in the eastern and western sections, thus doubling the potential "on the air" time.

In each of the operating sections all communications will be heard by all fixed and mobile stations. Any message originating in one section which is of interest to the other section may be repeated at Everett, thereby providing for complete coverage over the entire 327 miles of the Turnpike.

In addition, teleprinter facilities will be provided between stations at Valley Forge, the Harrisburg Turnpike office, Everett Maintenance Headquarters, tunnel portal buildings, and Gateway (Pennsylvania-Ohio Border). Through this medium printed messages may be transmitted and received at these locations at the same time that voice communications are being carried over the system.

The heart of the communication system is a chain of unattended microwave relay stations, strategically located at elevated sites along the course of the Turnpike. Operating in the 952-960 mc portion of the spectrum, recently made available by the Federal Communications Commission, these stations automatically receive and re-transmit messages across the entire Turnpike. At carefully selected locations, stations in the 152-162 mc band connect with the microwave relay system to provide for communication to fixed and mobile units in the area adjacent to each.

The radio communication system using R.C.A. equipment was engineered, designed, and is being installed by Raymond Rosen Engineering Products, Inc., of Philadelphia, Pa., working in conjunction with the J. E. Greiner Co. of Baltimore, Md., consulting engineers.



★ Broadcasting center for the Pennsylvania Turnpike Commission's new radio system. (Penna. Turnpike Commission photo.)

The radio system will be of great value to motorists and truckers. With patrol vehicles constantly cruising over the Turnpike, emergency messages to specific vehicles using the highway may be delivered promptly. Any motorist in distress (motor failure, etc.) is noticed promptly by such patrol. The radio system provides the next link which enables the patrol officer to immediately summon aid.

During the winter season sudden local sleet storms might go unnoticed without adequate communications, noted Mr. Evans. However, such conditions are discovered and the proper maintenance center immediately notified over the radio system. Cinder trucks then care for the icy road condition with a minimum of delay, thereby insuring the safety of the motoring public.

Open First Section New York Thruway

The first 13 miles of the New York State Thruway opened to traffic were constructed at a cost of about \$560,000 a mile, according to Chairman Bertram D. Tallamy of the Thruway Authority. The combined cost of building the Catskill-Saugerties section and the stretch near Victor, south of Rochester, was \$7,298,871.

Tallamy, who also is State Superintendent of Public Works, said another 32 miles of Thruway is now under contracts amounting to \$17,935,777. By the end of this year some \$65,000,000 in state funds are expected to be allocated to the New York-through-Buffalo expressway.

★ Will Wages Continue to Rise?

By Halbert P. Gillette

Five years ago the great war ended, and it was commonly predicted by professional economists that wage and price inflation had ended also. The writer disagreed, and published as evidence a table like the one here given, going back to 1849 when our census for the first time gave the total number of factory workers and the total wages received in a year.

In 1920 the writer first published this table, up to 1919, and announced finding an economic law:—Aside from effects of the velocity of circulation of the currency, average wages tend to change in proportion as per capita currency changes.

Study of the accompanying table discloses that annual wages in American factories have tended to be about 20 times per capita currency. In 1909 the ratio was as low as 15 to one; and in 1929 as high as 24 to one. In 1935, near the middle of our longest business depression, the ratio was about 20 to one. Hence the writer infers that average factory wages probably will soon rise to about $20 \times \$180$ or about \$3600 per annum. During the past 12 months the average rise has been about 6% to a level of about \$58 a week of 40 hours. At this rate of increase an annual average wage of \$3600 would be attained about three years hence.

The first column of the table shows that while annual money wages became 12 times as great in 1950 as a

century earlier, average wholesale prices only doubled. Hence, American real wages (measured in average wholesale prices) had become six fold in 100 years! Since retail prices tend to follow wholesale prices rather closely, real wages (measured in retail prices) also became about six-fold in a century if measured on the 1849 standard of cost of living. But since cost of living for most people is almost equal to their entire income, cost of living cannot be used as an economic yardstick over a long period of time.

As quoted in the writer's Handbook of Construction Cost, page 115, the Aldrich Senate Report of 1890 stated that the average length of the working day was 11.4 hours in 1840; 11 hours in 1860; and 10 hours in 1890. Since the factory week was about 66 hours in 1850 and is now about 40 hours, there has been a 40% decrease in the number of hours of work during the 100 years that real wages have risen 500%.

Stimulated by competition, enthused by the expectation of increasing income, and but slightly hampered by governmental or by labor-union control, American producers, managers, inventors and engineers have cooperated to increase individual output decade after decade for more than a century. The eagerness of immigrants to become Americans has attested a world-wide recognition of the unparalleled success of what has

come to be known as American Free Enterprise.

Our natural resources are great, but so are those of Russia whose population and acres exceed ours; but the average income of those people is that of serfs, which, in fact, they were under the tsars, and still are. The Kremlin boasts of progress, but publishes no statistics to prove it. On the contrary it erects an iron-curtain to conceal what it pretends to be proud of! Unless the nature of a Russian is sui generis—unlike that of all other men—that iron-curtain, though it remains impenetrable, by its very existence exposes their poverty, and assures us that, were it lifted, it would disclose an economic nakedness of which they are thoroughly ashamed.

Factory Annual Wage, Per Capita Currency and Wholesale Price Index

Year	Annual Wage	Per Capita Currency	Price Index
1849	\$ 247	\$ 12.02	83
1859	281	13.85	90
1869	378	17.63	122
1879	547	16.75	87
1889	445	22.52	99
1899	458	25.62	75
1909	516	35.41	94
1914	552	34.35	99
1919	1141	53.71	198
1925	1269	53.13	148
1929	1300	54.33	126
1935	1615	52.68	114
1939	1152	53.72	110
1949	2500*	184.41	135
1950	3000*	180.00*	—

*Approximate.

★ Replacement of Maintenance Equipment

In a substantial number of states, the highway department distributes its entire equipment cost, including depreciation, to the individual projects, using an equipment rental system to effect the distribution. In most cases, such systems are merely a device of bookkeeping and accounting, in that the department has no legal authority to accumulate depreciation reserves which may be used to replace equipment.

A few departments, however, have authority to accumulate such reserves, and by reason thereof are in a position to make replacements of maintenance equipment without awaiting action on the part of the state legislature. Under these circumstances, the maintenance organization is able to plan its mechanized operations with assurance that they will not be disrupted by obsolete or worn-out equipment, or by adverse political action.

A pioneer in this field is the State of Virginia.

Highway maintenance today is big business, its mechanization is growing rapidly, the administrative problems getting more complex. Now is a good time to give thought to new legislation that would permit maintenance equipment to be replaced more flexibly, when, where and as needed to give the most for the highway upkeep dollar.

In War or Peace

IT COSTS LESS TO BUILD GOOD ROADS THAN TO HAVE POOR ROADS



★ Typical loaders of the general type referred to in the accompanying article. (Atthey and Lull units shown).

Waiting for Trucks

Slows County Owned Pit Loaders

Following is summary of time studies on utilization of available working time of tractor front-end loaders, used in borrow pits on county road work in southern states. Issued as Report No. 18 by the Highway Research Board's Committee on Economics of Highway Construction and Maintenance (July, 1950) and as Highway Research Correlation Circular No. 111.

EQUIPMENT production studies made in 1949 on tractor front-end loaders on county road work, reveal that lack of hauling units at the loading site constitutes the greatest single source of delay to this class of equipment while engaged in loading select material in borrow pits.

These studies were conducted by the Production Cost Unit of the Bureau of Public Roads on 7 loaders operated in 3 counties in 2 southern states. One loader had a $\frac{3}{4}$ -cu. yd. capacity, whereas the others were all of 1-cu. yd. capacity. In each instance they were owned by the county and were operated by county personnel. Five of the loaders were manned with full-time operators, but in two cases the hauling unit drivers loaded their own trucks.

Table 1 shows the percentage distribution of 315 hours of total available working time as obtained from the studies. These and other data contained in this report reflect only the conditions that prevailed while working in borrow pits from August to October, 1949, and should not be interpreted as representative of year-

round usage during which this equipment may be employed on a variety of operations, such as cleaning up slides, loading slough bladed from ditches, loading stocked materials, and so on.

Table 1. Distribution of Total Available Working Time of Tractor Front-end Loaders in Borrow Pits on County Road Work.

Time element	Percentage of total available working time	
	Range	Average
Total available working time	100	100
Major delays	44-82	68
Net available working time	15-56	32
Minor delays	5-19	16
Actual productive time	9-37	16

In Table 1, the total available working time is the sum of normal daily shift time plus such occasional overtime as actually worked; major delays are individual delays of 15 min. or longer; and minor delays are individual delays of less than 15 min. The ranges shown in Table 1 represent averages for each loader during the period of study.

The extent of major delays of 15 min. or more due to various causes is shown in Table 2.

The practice with respect to having the county crews report for work was varied. In some instances the men reported for work at the job site, while in others they reported for work at the county shop and then were transported to the job site. These latter instances accounted for a portion of the major delays included in the

Table 2. Classification of Major Delays to Tractor Front-end Loaders in Borrow Pits on County Road Work

Nature of major delay	Percentage of total available working time
Bad weather	21
Repair and maintenance of unit	17
Lack of hauling units at loading site	15
Operator in-transit time to job site, excessive lunch hour, quitting early	7
Standby idle	5
Other	3
Total	68

fourth item in Table 2. In all cases, however, the shift time ended on the job and did not include in-transit time back to the county shop.

The classification of minor delays is shown in Table 3. Minor delays are ordinarily only a few seconds each in duration, and in Table 1 it will be noted they amount to 16% of the total available working time. However, the full extent of minor delays can usually be better visualized by comparing them to the net available working time. For example, when minor delays are expressed as a percentage of the total available working time, an area having frequent and extensive major delays such as bad weather tends to show a lesser percentage of minor delays than an area having a few major delays. Thus, a better basis for indicating the extent of minor delays in relation to the production operation is to express them as a percentage of the net available working time.

For the 7 loaders on which studies were conducted, minor delays varied from 34% to 65% of the net avail-

able working time with an average of 49%.

Table 3. Classification of Minor Delays to Tractor Front-end Loaders in Borrow Pits on County Road Work.

Nature of Minor Delay	Percentage of net available working time
Lack of hauling units at loading site	31
Personnel	3
Hauling unit maneuvers and delays	2
Repair and maintenance of unit	2
Maneuvers by the loader to maintain digging position or clean up work site	1
Other	6
Total	49

Table 4 is a composite summary for all loaders of the data relating to the cycle elements of the unit.

Table 4. Summary of the Average Cycle Data for Tractor Front-end Loaders in Borrow Pits on County Road Work.

Element	Range	Average
1. Load	8-19 seconds	13 seconds
2. Maneuver to dump site	10-23 seconds	15 seconds
3. Dump	1-4 seconds	2 seconds
4. Return	8-19 seconds	14 seconds
5. Total cycle (sum of items 1, 2, 3, and 4) ¹	31-65 seconds	44 seconds

¹Excludes all delays.

During the study of each loader an estimate was made of the pay yards loaded in each truck, and the resulting total was converted to average cubic yards per bucket of the loading unit. The composite yardage summary for all loaders indicates an average pay load of 80% of the rated capacity with a range between loaders of 71% to 87%.

A computation based on the productive working time rate of the units and the estimated yardage per bucket load shows that the composite average production rate of the units was 65 cu. yd. per hour with a range between loaders of 58 to 87 pay cu. yd. per hour of actual productive time, exclusive of all delays.

Sufficient studies have not yet been made to warrant analyses of the individual effect upon cycle elements and pay yardage of such factors as condition and type of unit, kind of material, height of digging face, operator efficiency, and so on.

New Jersey Highway Department Has New Modern Headquarters

New Jersey joins the states which have provided modern specially designed facilities for housing their state highway departments. The New Jersey highway staff has just completed the transfer of its base of operations from the crowded state house annex at Trenton, to the building shown in the accompanying aerial view, located at Fernwood in Ewing Township near Trenton.

The new building, which represents long and careful planning, includes a cafeteria with 300 seating capacity, kitchens for serving meals to employees, and a spacious parking area for personal cars of employees as well as department vehicles.

Space allocation has been worked out to place each division as close as possible to other divisions with which it works most closely. Within each division the layout of individual offices is made to facilitate inter-office contact.

The basement of the three-story structure, extending under the main section, houses the department's model shop, photographic laboratory, soils section and storage facilities.

The first floor includes modern reception facilities, administrative offices and space for the real estate, title bureau, purchases and stores, personnel and public relations, mailing room, mimeograph room, central files, con-

tracts, classification, federal aid coordinator, and legal. Also there is a hearing room where bids are received and public hearings held, with office of chief clerk and secretary adjoining.

The second floor houses three large divisions: maintenance, auditing and accounting; planning, economics and traffic; also smaller bureaus. The third floor, which is the engineering nerve center houses the state highway engineer, division of design and construction, survey and plans, state aid projects, bridge division, electrical division, and plan file.

Letters and Comments

To the Editor:

As you recognize in your July editorial "Traffic Safety Problem Challenges State Highway Engineers and Legislators," there is no single plan that will solve traffic accidents any more than there is any one cause of highway crashes. It is a broad, complex problem that needs to be worked on in all its aspects. There are many important causes and, likewise, necessary approaches to a solution. Engineering is not the sole answer, but yet very important. Education of our youth is very important, as well as a continuing program of education directed at adults; both have their place in the program.

What is needed, as I view the problem, more than anything else is harmonious team play on the part of all public officials whose actions affect the highways in any manner, together with groups of organized citizens, such as auto clubs, parent-teachers organizations, improvement clubs, newspapers, radio commentators, et cetera, et cetera. Any program thus obtained is, of course, a step in the right direction and a source of gratification, but it is a war that must be continuously waged and, sadly enough, it has no ending. But the benefits of the efforts of a highway safety program are well worth their cost.

Keep up the good work and help develop a harmonious team of those who can help in the good cause.

—Arthur H. Breed, Jr.,
Senator for Alameda County,
California State Senate

The Oklahoma Supreme Court has upheld validity of the \$31 million toll road bond issue authorized by the turnpike authority. Preliminary engineering work is progressing although it is reported that some Lincoln County farmers refuse to permit engineering crews on their land.



★ New Jersey state highway department's new home.



★ Surface maintenance is one of the primary purposes of the motor grader, and lighter, low cost, tandem drive motor graders are more than adequate for the majority of general maintenance work

Maintaining Dirt Roads

*By the Civil Engineering Department
of Allis-Chalmers Tractor Division*

PRIMARY and secondary roads under state control embrace about one-half million miles of the existing three million miles of rural roads. The remaining 2.5 million miles are classed as local rural roads, of which 95% are under the jurisdiction of local government and 5% under state control. About 52% of the local road mileage is unsurfaced, 38% is surfaced with granular materials and 10% has dustless surfaces.

There is, therefore, no lack of appreciation of the benefits of technical and mechanical aids in rural areas. There are also many country and local road engineers with a long record of efficient road maintenance accomplishment. The problem is one of conveying this maintenance experience to areas where there is a lack of technical guidance, adequate mechanization and the use of design standards which will facilitate maintenance.

What Size of Grader?

Surface maintenance is one of the primary purposes of the motor grader. In many cases, public maintenance officials have established an erroneous precedence toward the use of 100 h.p. motor graders to do general maintenance work. The lighter, low cost, tandem drive Model D motor grader is more than adequate for the majority of general maintenance work.

The average maintenance problem is to keep a smooth driving surface and at the same time save gravel, maintain the crown and prevent additional ditches from starting on the shoulders.

In previous days, the method was to windrow the gravel and loose material from one side of the road to the other. On many of the secondary dirt roads today, this is still the practice. Two-foot moldboard extensions are often used in order to move the dirt across in one round trip. Where crowns and proper drainage are important, this practice is not recommended.

The standard practice in dirt road maintenance is to pick the gravel and loose material up from both sides of the road and windrow it to the center in one or more round trips. Then the windrow can be spread back toward the sides in one pass by setting the blade straight across, or it can be spread by making another round trip casting half of the windrow to either side. This method enables the operator to keep the desired crown and to evenly distribute the loose material on both sides of the road.

Don't Cut Too Much

Too often, operators have a tendency to cut too much material away from the berm leaving a ridge of sod or dirt on the edge of the shoulder. This causes poor drainage from the road surface, resulting in water standing along the edges of the driving surface and also washouts on the shoulder when this water finds a place to run off.

Berms must be kept lower than the driving surface. It is often necessary to cut the berm down with the motor grader and remove the material with trucks. If berm is to be cut away it is advisable to move any gravel away from the shoulder before cutting the sod away.

Dirt surfaced roads become hard in some localities during hot dry summer months. These roads should be maintained after rain storms or damp weather when the dirt is in a workable condition. Hard surfaces may require a scarifier application before satisfactory blading can be accomplished.

Record-Breaking \$1,188 Million Federal Aid Road Bill to President

As this issue went to press the President had on his desk a bill passed by both houses of Congress, making available \$504,075,000 for federal highway aid for each of the fiscal years 1952 and 1953 (1951 and 1952 for certain items).

This bill, if it becomes law as anticipated, will provide federal funds for each of two years, as follows:

\$225,000,000	Primary System
150,000,000	Secondary System
125,000,000	Urban System
20,000,000	Forest Highways
17,500,000	Forest Roads and Trails
3,500,000	Tongass National Forest, Alaska
10,000,000	Park Roads
13,000,000	Parkways*
6,000,000	Indian Roads
5,000,000	Disaster Relief Fund
5,000,000	Roads through Unappropriated public Lands*
4,000,000	Inter-American Highway*
10,000,000	Defense Roads
75,000	U.S. Bureau of Public Roads Cooperation, President's Highway Safety Conference

*Fiscal years 1951 and 1952; items not starred are for 1952 and 1953.

Deleted from the bill is the provision giving the President power to make all the monies available in emergency for war road use. It includes (Sec. 13) provision requiring public hearings for by-passing cities and towns (not villages). The bill provides no funds earmarked specifically for the Interstate System. However, provision for issuance of bonds for improving the Interstate System was retained, with certain modifications specifying the State as the sole agency with which the Federal government would deal.

Highway Use of Motor Fuel. Highway use of motor fuel in 1949 amounted to 32,431,016,000 gal., according to the U. S. Bureau of Public Roads. Of this total 31,849,914,000 was private and commercial use, and 514,139,000 was public use by states, counties and cities.

Extensions for

Many months saved by aerial mapping for preliminary location, geophysical soils investigation, and deployment of construction designing among private engineering organizations.

Contractors' high production achieved largely with time-tried methods; power scrapers handled relatively larger yardage compared with original turnpike construction in 1938-1940.

Special Staff Report

THE 100-mile Eastern extension of the Pennsylvania Turnpike is completed except for the clean-up and a few trimmings. Its dedication in October will increase to 260 miles the distance which motorists and truckers can drive over this famed highway without meeting an intersection at grade.

The Turnpike is also being extended 67 miles westward to the Ohio line, and this leg is under contract throughout its entire length with completion set for late 1951. When the job is done the road will span one-eighth of the continent. And this eighth can be driven safely and easily in 6½ or 7 hours by car, a little longer by truck—a fact sure to have impact on future highway development elsewhere in this country.

Signals New Trend


The extension program is financed by revenue bonds through an investment banking group. Signalling the start of a new trend in highway financing, this financing in 1947 included refunding of the old Turnpike bonds and money for the eastern extension, through a record-breaking \$134,000,000 issue of revenue bonds. Similar financing of the Western extension brings to \$211,000,000 the Pennsylvania Turnpike Commission's revenue bonds outstanding.

Construction cost for the Eastern extension will be about \$86,400,000, or about \$864,000 per mile; for the Western extension, \$78,300,000, or \$1,170,000 per mile. This compares with \$461,000 per mile for the original turnpike construction in 1938-40.* The figures are not exactly comparable, since the earlier section included completion of 7 old railroad tunnels totaling 6.7 miles in length for highway traffic use, while the extensions include major stream bridges. But they do roughly afford a measure of the inflation that has occurred.

Burst of Speed


The Eastern extension, as with the parent Turnpike, was designed and built with nearly "all out" speed in order to hasten the beginning of toll revenue and shorten the public's wait for the much needed facilities. The advance engineering job was compressed into a year's time and the construction work largely into 24 months. The first construction contract was awarded in September, 1948. Today the contractors working under 27 roadway or structure contracts have largely completed 121 grade separation structures, 72 major stream crossings (includ-

* Compared with \$560,000 per mile average cost for the first 13 miles of the New York Thruway recently completed, and \$1,000,000 per mile eventual cost of entire Thruway. The New Jersey Turnpike's cost will exceed \$2,000,000 per mile.



★ The Philadelphia extension seen under construction through rich "Pennsylvania Dutch" Lancaster county, where its location hugs the forested foothills.

★ The original Turnpike required occasional 3 deg. curves in mountainous country. The Extensions are designed with 3 deg. maximum curves. (Photo courtesy Pennsylvania Turnpike Commission).



the Pennsylvania Turnpike

ing the \$4.8 million Susquehanna River bridge), 15,000,000 cu. yd. Class I excavation and 2,990,000 sq. yd. of concrete paving.

Eighteen contractors handled one or more sections, aided by 33 sub-contractors, under a policy of the turnpike commission requiring each contractor to be responsible for completion of the construction of his section, but placing no arbitrary limit on the percentage of the work he could subcontract to qualified firms. Subcontractors placed most of the structures, and often took either the grading or the paving.

Located by Air

Among the most newsworthy phases of the extension program was the advance engineering. Prior to the bankers' "go ahead," the approximate location of both the Eastern and the Western extension had been determined upon with the help of U. S. Geological Survey air maps. During the autumn months of 1947 the Eastern route was flown under a contract by Aero Service Corporation, of Philadelphia. The tentative location line was covered by an air strip map taking in approximately one mile of width, the strip maps being scaled 200 ft. to the inch. Stereo methods helped produce contours at 5 ft. intervals. These maps and contours were employed in area identification of surface soil types, in determining the final location, and in making preliminary estimates.

The mapping and locating job was done by early 1948—requiring only five months, and saving an estimated year or more of time compared with traditional ground methods.

Then as soon as possible the Turnpike Commission entered into contracts with several consulting engineering firms for furnishing complete design plans and cost estimates based on turnpike standards and procedures. Consultant staff field parties staked

the centerline and took cross sections as the basis for engineering plans. While the blueprinting job was in progress, the Turnpike Commission through its own staff began making test borings, augmenting boring data with earth resistivity and geological investigations. Geophysical and geological work on the Eastern extension represent the most extensive use of such methods to date in highway construction, and the first instance where engineering geology played a key role in the design of a major highway project. Believing this to be perhaps the most important engineering development coming out of the Pennsylvania Turnpike extension program, the editors of *ROADS AND STREETS* have secured a detailed account of the procedures and results. [See article by A. B. Cleaves and H. Leroy Scharon, elsewhere in this issue.]

Roadway Design Basis

The Extensions will embody the tested design features of the original turnpike section, with several changes based on careful review of available highway performance and soils engineering data made available during the past decade. Grades are held to 2%, and curves to 3 degrees or less. This compares with 3% grade and 6 degree curve maximums on the original section, where the terrain is more rugged.

The extensions will have dual 24-ft. roadways, in keeping with the original turnpike. It is noteworthy that 24 ft. width for two traffic lanes—considered quite advanced when adopted in 1938—is now standard for heavy traffic, and is believed to be the greatest width presently feasible for a 2-lane express roadway. This width is satisfactory from both the safety and capacity standpoints, according to turnpike experience and highway capacity studies made recently by the Bureau of Public Roads.

The median strip continues 10 ft.

wide, but an important design change has been introduced. Instead of being made high in the center and draining across the pavements, the grassed strip will drain to its center. A line of 6-in. tile buried 2½ ft. deep under the strip will feed to inlets at frequent intervals.

Cut slopes also drain into inlets, and 6-in. drains extend along ditch lines through many cuts. Cross drains of 18-in. or larger concrete pipe extend under the pavement, and carry storm water through cuts or to run-downs on embankments.

Special Subgrade Provided

Another new design element is a 6-in. special subgrade, which extends 78 ft. wide or out-to-out of shoulders. This layer of granular material slopes laterally from the center, to aid good drainage. The special subgrade along with thorough base compaction, under-drainage, use of air entrained concrete and reduction in the number of pavement joints, is the Turnpike Commission's carefully devised answer to the problem of pavement durability under heavy traffic. The over-all design of sub-grade and pavement resulted from study of available data on concrete pavement performance under heavy traffic, including the final analysis of the Highway Research Board's committee on pumping of concrete pavements. The army engineers' report on performance of airfield subbases was also studied.

Explicit specifications and rigid inspection were set up to assure a stable, compacted but free draining special subgrade layer, in the belief that a high grade support under the concrete is essential for heavy traffic.

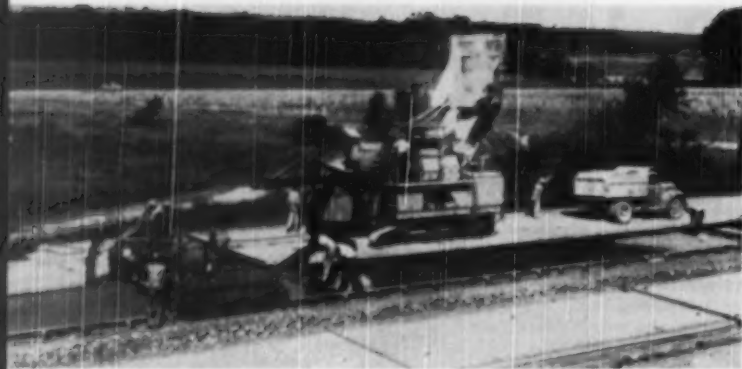
Special subgrade specifications permitted a wide range of local materials including stone, gravel, sand, slag or any material either run-of-bank or run-of-crusher meeting the gradation specifications, depending on the type of material elected by the contractor.

Low Bid Prices—Pennsylvania Turnpike Extension

Item	Unit	Low	High	Average
<i>(Eastern Extension)</i>				
Class I Excavation	C.Y.	.42	1.05	.72
Class II Excavation	C.Y.	2.50	5.60	3.37
R. C. Conc. Point (9"x12")	Sq. Y.	4.35	5.05	4.87
Reinforcing Bars	Lb.	.09	.12	.094
Structural Steel	Lb.	.15	1.00	.35
Class B Concrete	C.Y.	25.00	42.00	36.30
Class A Concrete	C.Y.	39.00	63.00	47.54
Special Subgrade (6")	Sq. Y.	.25	.70	.517
Shoulders	Sq. Y.	.50	2.25	1.38
<i>(Turnpike Std.)</i>				

Item	Unit	Low	High	Average
<i>(Western Extension)</i>				
Class I Excavation	C.Y.	.47	.69	.554
Class II Excavation	C.Y.	2.50	4.00	3.96
Conc. Pavement	Sq. Y.	4.40	5.00	4.45
Class B Concrete	C.Y.	28.00	37.50	32.70
Class A Concrete	C.Y.	37.50	70.00	44.80
Special Subgrade	Sq. Y.	.34	.60	.48

Submitted by successful bidders on various dates between Sept. '48 and Sept. '49 for the Eastern Extension; between Oct. '49 and July '50 for the Western Extension.



★ Mile-a-Day, Williams Paving Co., working under contract by Pennsylvania Quarry, Strippling & Co., (Sect. 21B2 and 22A1), recently placed 5302 lin. ft. of 9"x12" slab in a 13½-hour day. Two MultiFooters pavers used, a dual end and a single drum. The dual-drum paver, shown here working alone, previously had placed as high as 3,547 lin. ft. in 13 hours single-handed.

Concrete Slab Design

The pavement on the original turnpike consisted of a 9-in. uniform thickness reinforced concrete slab placed on the natural subgrade. Expansion joints were spaced 77 ft. with no contraction joints between. Despite pumping recently along certain sections, this pavement is considered to have given an excellent performance.

During its decade of service traffic has risen steadily, until the 1949 count averaged 10,545 vehicles daily, 23% being trucks and buses.

The slab thickness of 9 in. for the extensions is unchanged from the original road, but details are modified to include a dowelled contraction joint every 46½ ft., and ¾-in. dowelled expansion joints at approximately 900 ft. intervals, or at ends of horizontal curves and at bridges which interrupt the slab. Expansion joints at structures are 1 in. thick.

Transverse contraction joints are made with metal separation plate, with 1"x24" dowels spaced at 12 in. ctrs. Expansion assemblies include premolded fiber joint and 1"x12" dowels at 10 in. ctrs. Rubber seal compound is specified to be poured flush, the seal being ½ in. deep for con-

traction and 1 in. deep for expansion joints. One end of dowels of contraction joints are oiled.

The longitudinal joint is keyed and tied with ¾"x48" tie bars, on 5 ft. centers, pin supported on either side for 2-lane or 24-ft. width construction, and screw hook bar dowels for single or 12-ft. width construction.

Equipment requirements included two pavers on hand, and two sets of power finishing equipment except in unusual cases. Also a scratch template, four or more drag straightedges 16 ft. long, three or more testing straightedges, burlap belt drag, and double burlap cure cover for 24 hours followed by paper or mats. A surface tolerance of ¼ in. in 16 ft. reflects the tightening up on smoothness requirements by various highway agencies today.

The concrete mix was designed on a basis of a minimum of 6.25 bags per cu. yd. and a maximum of 5.3 gal. per bag using cement with the air entraining agent interground.

Grading Specifications

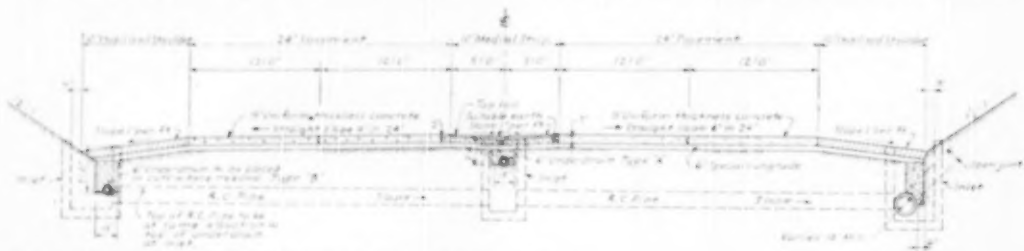
Embankment specifications vary considerably between the Eastern and the Western extension. For the Eastern extension, which traverses good soil material on the average, no

density specification was included in the contract specifications. But all earth or friable fill material was required to be placed and thoroughly rolled in 4 in. compacted lifts, using 3-wheel steel rollers. Approved sheepfoot or wobble-wheel pneumatic tired rollers were permitted under some soil conditions. Grading entailed use of three or more steel rollers on a typical operation, with relatively little use of sheepfoot, or perhaps none. Pneumatic tamping around structures was thoroughly done.

Rock fills on the Eastern end were permitted on approval of the contractor's grading plan by the engineers, and after examination of the material involved. Rock was placed and rolled in 2 ft. max. lifts, except for the top lift, which was required to be an 8-in. layer thoroughly choked and rolled. Fills were topped out by 6 in. compacted depth of earth cover.

Whereas the Eastern section passes through sharply folded granite, sandstone and shale beds of geologically very old origin, the Western extension traverses an area of flat lying strata, consisting of an indurated plateau of material geologically falling in Pennsylvania. This material abounds in unstable mudstone, siltstone and shale, and the valleys are filled with talus, with glacial deposits near the Ohio line. Hence an entirely different approach was taken in setting up grading specifications on the west.

Specifications on the west require compaction of fills to 95% of standard AASHTO density. Sheepfoot rollers, with at least 350 psi. unit weight on feet, are required for this grading work, which is currently in full swing. The density clause was included principally as a means of insuring good workmanship when the engineers are in doubt of the contractor's methods. While density samples are taken every day on every job, they are for "indicative" purposes mainly, to keep the engineers informed on densities. Soils of HRB classification A-5, A-6 or A-7 with Group Index more than 12 are required to be wasted unless mixed with at least 50% of material



★ Typical cross section (tangent) of Pennsylvania turnpike extension roadway.

A-4 or better. Earth or friable material is placed in layers not exceeding 8 in. loose depth and must be compacted at near optimum moisture "until no further consolidation is obtained or until thoroughly consolidated to the satisfaction of the engineers."

Rock fill on the Western end is being placed in 2-ft. rolled, choked lifts, and is required to be placed outside the theoretical shoulder lines whenever practicable. Rock containing sufficiently fine material to fill all interstices is treated as earth and lifts limited to 8 in. and maximum stone size to 6 in. The top 9-in. lift of rock fill is limited to material containing not more than 25% of stones larger than 4 in.

Work on both extensions of the Pennsylvania Turnpike System is under direction of the Pennsylvania Turnpike Commission which includes T. J. Evans, chairman; James F. Torrance, secretary-treasurer; James J. Coyne, Edward N. Jones and Ray F. Smock, Secretary of Highways, Ex-Officio. Roger B. Stone is chief engineer and John D. Paul is assistant chief engineer. George H. Rahn is materials engineer.

Notes on Construction

A typical contract document, for a 3.2-mile section of the Eastern extension involving 480,000 cu. yd. of Class 1 excavation, 107,000 sq. yd. of concrete pavement and several major structures, included the following minimum equipment requirements:

- 3 2-yd. shovels
- 5 12-yd. wheeled scrapers
- 1 1/2-yd. power cranes
- 5 tractors with bulldozers
- 4 power graders
- 4 14-ft. construction mixers
- 5 16-ton 3-wheel power rollers
- 1 8-ton tandem power roller
- 1 5-ton 3-wheel power roller
- 1 34K paving mixer
- 1 27K paving mixer
- "Sufficient" wagon drills, pumps, compressors and tampers

The contractors for the most part kept to standard familiar methods, and settled down to a production race. Clearing and early-stage grading was a slow process in some areas, due to deeply fissured rock surfaces, interspersed with mudpockets and strewn with huge boulders. Shovels were the mainstay, although some of the contractors afforded conditions for use of tractor-drawn and self-propelled scrapers, and at least one contractor used a Euclid loader. Paving methods included both single-lane and full-width placement, and one-paver and two-paver set-ups, although single-lane pouring with two pavers predominated.

A typical contractor's outfit was

Companies Which Built the 100-Mile Philadelphia Extension

(Contract sections listed in order from West to East along the road)

Contract Section	Length	Successful Bidder	Price	Subcontractors	Price
224 21-A1	1.6 mi.	Frank Mashuda, Portersville, Pa.	\$1,319,982	J. Richard Neaseley, Landisville, Pa. (structures)	\$61,440
				Allegheny Asphalt & Paving Co., Pittsburgh (asv. & str.)	\$46,894
				A. R. Coffeen, Decatur, Ia. (structures)	\$7,912
208 21-A2	4.8 mi.	J. Robert Basley, Inc., Pottsville, Pa.	1,934,236	Brown, Davis & White, Lebanon, Pa. (structures)	\$65,018
221 21-B1	4.3 mi.	Johnson, Drake & Piper, New York, N.Y.	2,500,937	Harrison Const. Co., Pittsburgh, Pa. (grading)	\$64,448
				Henkels & McCoy, Philadelphia (landscaping)	\$14,167
223 21-B2	5.3 mi.	Central Penns. Quarry, Stripping & Const. Co., Hazleton, Pa.	3,282,516	Reed & Kuhn, Elizabeth, Pa. (structures)	\$1,035,616
223 22-A1				Williams Paving Co., Inc., Norfolk, Pa. (paving)	\$26,162
225 22-B	3.2 mi.	Patterson Const. Co., Monaca, Pa.	1,849,199	G. A. & F. C. Wagman, Inc., Dallastown, Pa. (structures)	\$21,707
				Piercon Contracting Co., Saginaw, Mich. (pav.)	\$67,781
261 22-C	3.4 mi.	Central Penns. Quarry, Stripping & Const. Co.	2,361,275	Reed & Kuhn (structures)	\$39,795
266-7 22-CB	Susquehanna River Bridge at Steelton (0.8 mi.)	Booth & Film Co., Pittsburgh, Pa.	4,777,500	Bethlehem Steel Co., Bethlehem, Pa. (superstructure)	\$2,119,500
				C. S. Stetler, New Cumberland, Pa. (place reinf. steel)	\$40,000
209 23-A	4.6 mi.	C. J. Langenfelder & Son, Inc., Baltimore	2,509,829	G. A. & F. C. Wagman, Inc. (structures)	\$45,138
211 23-A1	Swatara Creek Bridge	John W. Wickorsham, Lancaster, Pa.	442,712	None	—
265 23-B	4.3 mi.	H. J. Williams, York, Pa.	1,766,216	H. T. Osborn & Co., Franklin, Pa. (structures)	\$32,833
263 23-C		Patterson Const. Co., Monaca, Pa.	1,699,875	G. A. & F. C. Wagman, Inc. (structures)	\$26,264
210 24-A	5.3 mi.	Harrison Const. Co., Pittsburgh, Pa.	\$3,381,286	Allegheny Asphalt & Paving Co. (str.)	\$703,578
				Stewart & March, Inc., York, Pa. (structures)	\$20,795
				Williams Paving Co., Norfolk, Va. (paving)	\$22,205
202 24-B	4.3 mi.	C. W. Good, Inc., Lancaster, Pa.	1,763,540	None	—
204 24-C	3.90 mi.	John W. Swanger, Inc., Lancaster, Pa.	1,803,317	None	—
215 25-A	4.95 mi.	H. J. Williams Co., Inc., York, Pa.	2,048,767	H. T. Osborn & Co., Franklin, Pa. (structure)	\$66,867
216 25-B	2.7 mi.	Ralph Myers Contracting Corp., Salem, Ind.	1,896,394	C. & T. Construction Co., Inc., Collinswood, N.J. (structures)	\$73,292
				Brayman Const. Co., Pittsburgh, Pa.	\$19,775
				Harry C. Erb, Inc., Philadelphia, Pa.	\$42,367
219 25-C	8.5 mi.	C. W. Good, Inc., Lancaster, Pa.	4,002,784	None	—
220 26-A					—
226 26-B	6.4 mi.	Loyalhanna Const. Co., Pittsburgh	2,797,356	None	—
227 26-C	3.8 mi.	C. J. Langenfelder & Son, Inc., Baltimore	3,707,788	Koppers Co., Inc., Baltimore (structure & drainage)	\$24,154
212 27-B	3.8 mi.	S. J. Groves & Sons, Inc., New Milford, Pa.	2,222,715	Kingson Contracting Co., Lattimer Mines, Pa. (structure)	\$55,785
213 27-C	8.6 mi.	Lane Const. Co., Meriden, Conn.	4,881,238	A. R. Coffeen, Decatur, Ia. (structures)	\$7,912
214 28-A				G. & H. Steel Service, Inc., Drexel Hill, Pa. (placing reinf.)	\$8,720
				Henkels & McCoy, Philadelphia (seeding, etc.)	\$5,465
217 28-B1	7.7 mi.	L. G. DeFolice & Son, Inc., North Haven, Conn.	4,689,417	Manger-Smith Com. pany, Columbus, Ohio (structures)	\$57,957
218 28-B2				Condit & Foundation Corp., Philadelphia (structures)	\$17,140
				Folsell & Angelucci, Philadelphia (pav.)	\$4,348

Also subcontracting for L. G. DeFolice & Son: Henkels & McCoy (guard rail) \$35,148; Allied Painting Co. \$11,625 Worcester, Mass. (painting)



★ Seen on Ralph Myers contract (Sect. 25B): 2.72 miles of line and 585,000 cu. yd. of excavation. Rock equipment: 1 Chicago Pneumatic 500 and 1 Jaeger 400 compressor; 5 wagon drills (Cleveland, others); Timken bits; Atlas 40% dynamite. Drilling seen in progress for 190-hole blast using 2-2 1/4 in. bits, near end of 270,000-yd. cut. Two 2 1/2-yd. shovels (Bucyrus-Erie S2-B and Northwest 80D).

Myers outfit also included 3 Terracabras (Woodridge); 1 D8 with LeTourneau scraper; 5 D7 and D8 Caterpillar tractors, some with dozers; 12 Euclid end-dump wagons; 5 Buffalo-Springfield 3-wheel rollers; 2 Caterpillar No. 12 graders; 1-yd. Northwest with Hendrix drag bucket; P&H pullshovel; LeRoi tractor compressor; Independent Pneumatic tampers; 2000-gal. water truck; Rogers machinery trailers. Contractor moved 100,000 cu. yd. in August, 1949, first month of work; 9,000 yd. on good days; short haul job.



With the Contractors on the Philadelphia Extension

★ Fissured, mud-pocked boulder fields slowed early stages on some contracts. Lorain shovel and Caterpillar-LeTourneau dozer loading Euclids on Harrison job.



★ One contractor is seen working a cut, while contractor on adjoining section has completed placement of special subgrade.

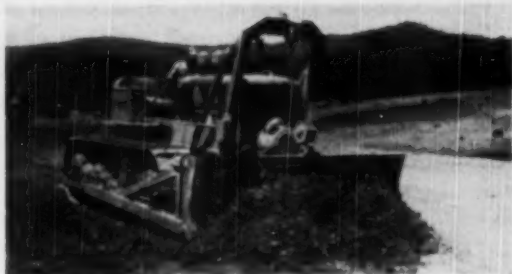
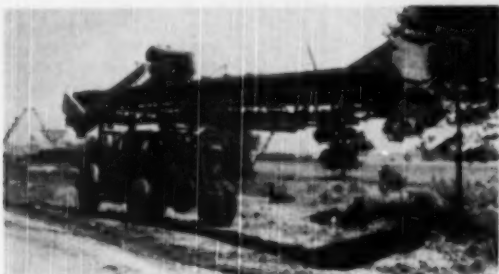
★ On the H. J. Williams contract (Section 23-B), three Jaeger 315 compressors served six wagon drills.

★ High-speed scrapers found important work on the Philadelphia extension. Patterson Construction Company used LePlant-Chester TS-300 motor scrapers (shown) and C Tournapull; topping out 100,000 yd. RR.



★ Cuts were extensively drained along ditches with tile lines; John N. Swanger, Inc., job.

★ Portable conveyor or belt, C. W. Good, Inc., devised this unit by mounting a standard motor-driven belt unit on a steel frame and swivel base, located over the back end of a trailer truck.

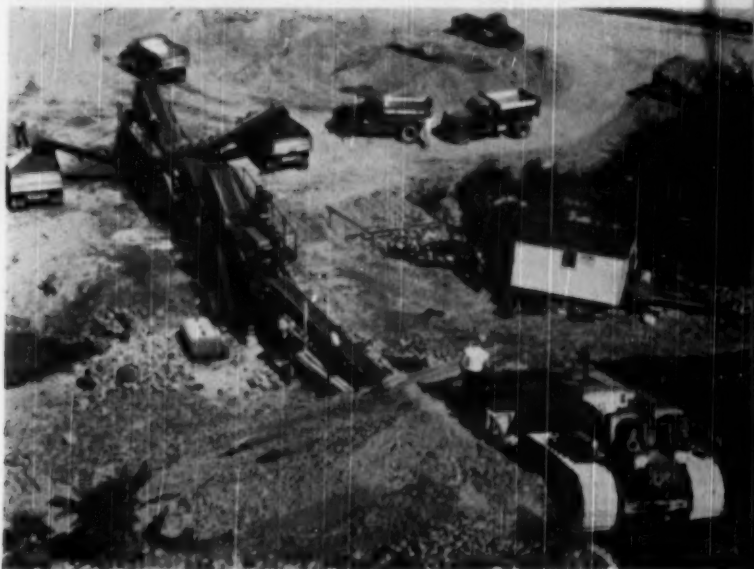


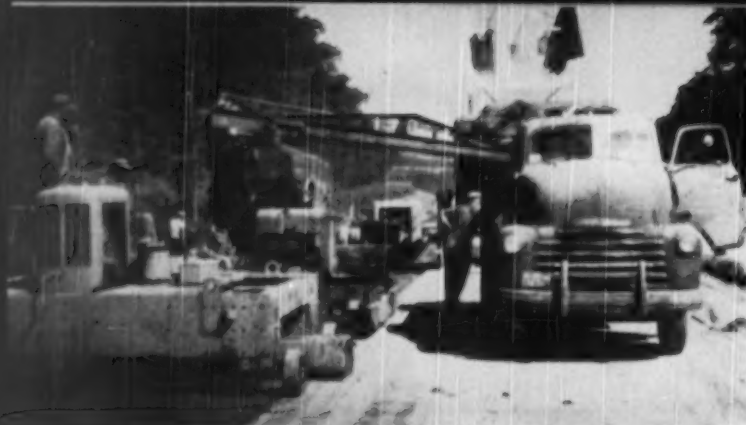
★ Very heavy tractors predominated for desert use. HD19 Allis-Chalmers unit on the C. W. Good, Inc., job, dressing bottom of cut.

★ On the M. J. Williams contract—D8's with No. 80 Caterpillars.



★ Several contractors found it handy to place crushed stone ditch backfill with transit-mix trucks.

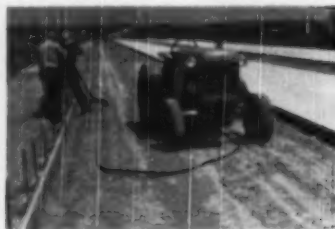




★ M. J. Williams' paving equipment included a Rex 34-E, 2 Jaeger spreaders, 2 Jaeger finishers. Best day: 2575 ft. of 9' x 12' slab. Chevrolet (shown), GMC and Dodge dump trucks used.



★ The special subgrade was thoroughly rolled in two 3-in. layers using steel rollers principally. Various local materials were permitted under the specifications—see article.



★ Form pins were driven mechanically on virtually all paving contracts—necessitated by thorough compaction of the granular subgrade. LaRoi Tractor (Allegheny Asphalt Paving Co.). Frank Washuda general contract.



★ Scattering wire mesh along the Swanger project—expedited by use of a trailer.

★ Large-capacity batch plants, laid out for straight-line loading, were necessary to support the fast paving schedules. The H. J. Williams plant (Sec. 23-B) included a 2-yd. Lorain crane, 100-ton Butler stone-sand bin, two Butler cement stations. Dodge truck shown.



(Continued from page 49)

that of C. W. Good, Inc., of Lancaster, Pa. This firm in October, 1948, was awarded Section 24-B, consisting of 4.36 miles, for \$1,763,000, and in July, 1949, also took Section 25-C and 26-A adjoining, totaling another 8.53 miles at \$4,002,700. Much of the company's equipment saw action on both projects.

As seen on the 24-B contract during mid-summer of 1949, this contractor's equipment and methods were as follows:

Grading: 2 Northwest shovels (2 and 1½ yd.) loaded to 8 bottom-dump and 2 rear-dump Euclid wagons and 1 LeTourneau wagon. The scraper outfit included 2 LeTourneau pans; 4 Allis-Chalmers HD 19 tractors; 2 A-C HD-14 tractors with dozers; 1 heavy LeT ripper; 1 Galion motor grader; several assorted wagon drills and jackhammers (variable); 2 Schramm 315 compressors; 3 three-wheel rollers (Huber and Galion).

Under Drains. Buckeye ditcher and 3 pullshovels (Unit and Northwest). 6-in. perforated clay tile with collars was placed as ditch drains, and backfilled using transit-mix trucks to transport and chute dry stone. (This labor saving device and means of utilizing available equipment was also observed on one other turnpike contract.)

Special Subgrade. Material dumped by truck into windrows, spread with graders and dozers taken from the grading work, sprinkled and rolled.

Ahead of Paver. Over a mile of road forms used; set with Cleveland Form-grader; pins driven by a converted paving beaker and Schramm 105 compressor. Subgrade roughed out by heavy roller-drawn bull-screed, followed by a Buckeye fine-grader. Two tandem (3 and 5 ton) rollers and one 8-ton 3-wheel roller compacted subgrade. The contractor used two scratch planes. Joint assemblies and wire mesh were furnished by Bethlehem.

Paving and Finishing. A maximum day's run of 3300 ft. of single-lane pavement was placed using a Rex and a Koehring 34E dual paver. Two Blaw-Knox spreaders and 2 Blaw-Knox oscillating screed finishers were followed by a Koehring longitudinal float, burlap curing cover for 24 hours, then Sisalkraft paper. Two 2,000-gal. water tanks plus a relief tank truck were required for the paver.

Batch Plant. Crushed limestone in two sizes. The plant included a Heltzel 3-compartment bin served by a Northwest 2-yd., a Lima 1-yd. crane and an Osgood ¾-yd. truck crane, the

Quantities in the Philadelphia Extension Project

15,125,000 cu. yd. Class 1 Excavation
550,000 cu. yd. Class 2 Excavation
57,200 cu. yd. Class "A" Concrete
137,500 cu. yd. Class "B" Concrete
4,870,000 sq. yd. Special Subgrade
2,810,000 sq. yd. Concrete Pavement

larger clambucket being a Haward. Heltzel bulk cement dock. Batched materials were hauled to the pavers in 3-compartment trucks, with separate covered containers for cement.

Subgrade Material Crushed on Job. Five contractors on the Philadelphia extension produced subgrade blanket material on the job. One was Patterson Construction Co., of Monongahela, Pa., whose 3.24-mile \$1,850,000 contract (Sec. 22-B) adjoins the Susquehanna River crossing near Harrisburg. A huge pile of air-cooled slag through which an 82,000-yd. roadway cut was required, proved satisfactory material for special subgrade.

Slag Pile Capitalized

An Austin-Western portable crushing and screening plant was set up at the base of the pile and material fed to it through slots using a router and two D8 Caterpillar dozers. A large quantity of material was produced at the rate of 1,500 to 1,800 cu. yd. per 9-hour day. The first of two mobile units, set up in line, consisted of a 20x36 primary jaw crusher, Simplicity vibrating screen, and UD 18 International power plant. The second unit was an Austin-Western 100 plant with Simplicity screen, 9x40 jaw crusher, 2nd screen deck, 20x30 roll crusher, and Murphy diesel power. Material from ½ to 1½ in. was taken off for the ballast lift, and ½-in.-minus material for choke stone.

The slag was reported to be very hard and difficult to crush, and Pierson Construction Co., of Saginaw, Mich., the subcontractor, is said to have devised a special toggle plate and used extra heavy springs back of his rolls, as part of his "trade secret."

Patterson Construction Co. graded this job using three LaPlant-Choate TS-300 motor scrapers and one C Tournapull. Drainage was handled by a Lorain mobile crane. Subgrade and paving equipment included a Jaeger power spreader for special subgrade material; Huber 3-wheel roller.

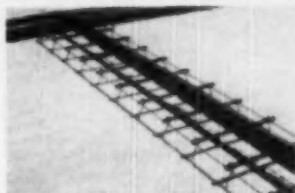
★

★



★ Several contractors used modern spreaders for the special subgrade. Jaeger spreader on Patterson contract.

Turnpike Engineers Demanded Painsstaking Attention to Paving Details



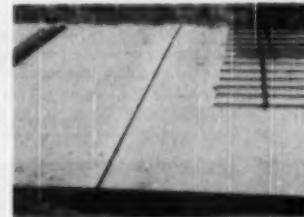
★ Joint assemblies were checked for accuracy with a chalkline. Every dowel in exact position.



★ This contractor used pair of burlap drags along edges to supplement burlap belt.

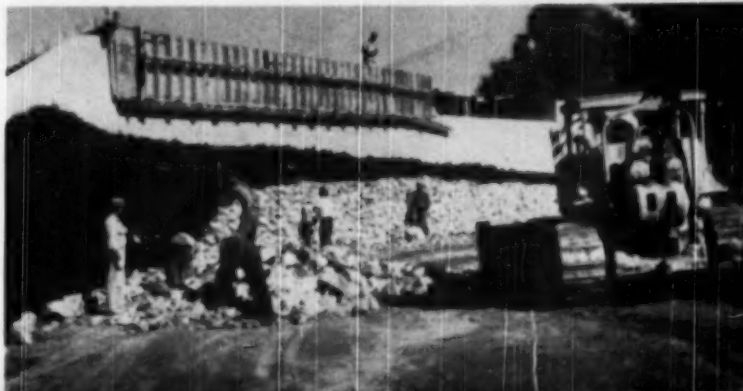


★ Edgers equipped with long handles saved backaches and also manhours. (C. W. Good, Inc., project 24-B).



★ Example of the perfect joint workmanship prevailing along the Philadelphia Extension.

★ Hand-laid stone courses were sometimes specified behind structures for good drainage, in conjunction with 6-in. tile around the footing.



Electrical Resistivity

Surveys and Test Borings Expedited Pennsylvania Turnpike Extensions

One of the newest and most important developments in highway engineering, geophysical exploration of excavation and foundation areas helps take the gamble out of road grading, enables contractors to estimate and bid more closely. The electrical resistivity method was given its most extensive and successful highway application to date in connection with the 160-mile \$150,000,000 extensions to the famed Pennsylvania Turnpike, now under construction in Eastern United States.

By Arthur B. Cleaves

Chief Geologist for the Pennsylvania Turnpike Commission, and Professor of Geology at Washington University, St. Louis, Mo.

and H. LeRoy Scharon

Chief Geophysicist for National Lead Company, Consulting Geophysicist for the Pennsylvania Turnpike Commission, and Associate Professor of Geology at Washington University in St. Louis.

DURING the construction of the original Pennsylvania Turnpike between Carlisle and Irwin, information relative to the thickness and physical characteristics of the overburden and bedrock was confined to surficial geological studies and test borings in the deeper cuts, the tunnels, and specific bridge sites. Subsurface investigations along the routes of the new Philadelphia and Western Extensions were greatly expanded and

were also augmented by the use of the Electrical Resistivity (geophysical) Method.

Nearly every cut deeper than 15 ft., many fill areas and some bridge sites were investigated by the electrical resistivity method in conjunction with test borings.

Similar studies have been made on highways in Arkansas, Missouri, Georgia, North Carolina, Tennessee, Virginia and the District of Columbia. However, it is believed that these Turnpike Extension surveys covering 100 miles on the Philadelphia Extension and 66 miles on the Western Extension comprise the most comprehensive application of this type of study made on any major highway in the United States.

The advantage gained from the application of such surveys is derived

from a saving in the number of test borings required to investigate a particular site, the speed with which the work can be done, the mobility and light weight of the equipment, and the simplicity of operation.

Theory of the Electrical Resistivity Method

R. Woodward Moore in the Bureau of Public Roads assisted in initiating the Turnpike studies. In the August issue of "Public Roads" he describes in detail the different geophysical methods of subsurface exploration in highway construction*.

Very succinctly he explains that the earth materials occurring in the earth's crust can be identified to a certain degree by their reaction to the flow of a direct electric current. These different earth materials because of their variable moisture content, impurities and other physical characteristics have distinctive resistances to the flow of an electric current through them.

Moist soils such as many clays and silts, with an active electrolytic agent, show a relatively low resistance. On the other hand gravel, sand, very dry loose soils, and solid rock generally have high resistivity values. Nevertheless it is desirable in a new field area to calibrate the instrument with tests over local soils and rocks. If these materials are exposed in a cliff face or test pit, or have been determined as a result of an adjacent bore hole, the plotted "curves" resulting from the resistivity tests are known in relationship to a definite sequence of earth materials. Consequently, the "curves" obtained later on in the same general area, but for unknown subsurface conditions may be compared and an accurate postulate made for the con-

*Moore, R. Woodward: Geophysical Methods of Subsurface Exploration in Highway Construction; Public Roads, Vol. 26, No. 8, pp. 49-64, August, 1959.

Reprints Available

Reprints of this article are available at cost of 25 cents each, payable in stamps. Please address Harold J. McKeever, Editorial Director, ROADS AND STREETS, 22 West Maple Street, Chicago 10, Ill.



★ Electrical resistivity equipment demonstration by field party on the Pennsylvania Turnpike.

cealed earth materials. This has been found to be so accurate in practice that the method is no longer questionable.

"As an electric current is passed through the ground from a direct current supply, usually one or more radio C-batteries, using the two outside electrodes C1 and C2. Measurement is then made of the drop in potential between two intermediate points P1 and P2, symmetrically spaced at the third points between the current electrodes. The current flow is determined with the milliammeter and the voltage or potential drop with the potentiometer, from which the resistivity of the material is computed by use of the formula.

$$\rho = 2\pi A \frac{E}{I}$$

in which

A is the electrode spacing, in centimeters

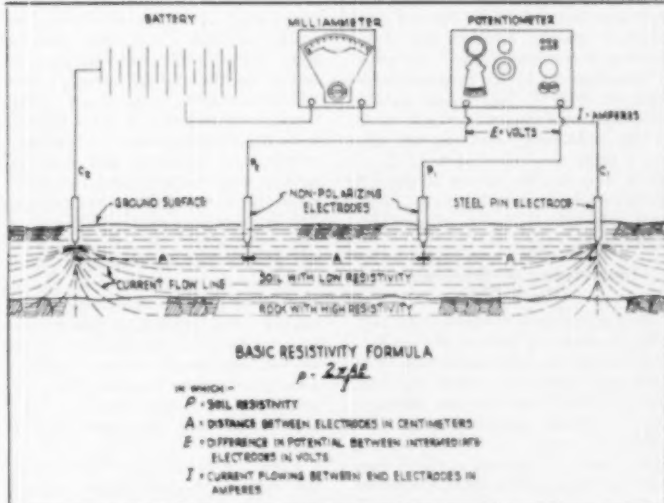
E is the drop in potential, in volts

I is the current, in amperes, flowing in the circuit."

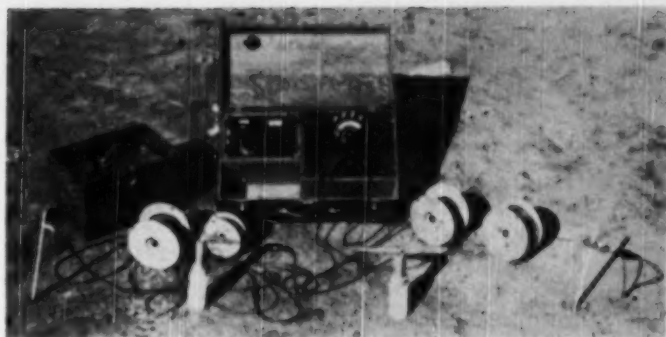
There is an empirical relation such that the "effective" current flows within a depth below the surface equal to A. Hence, if A (electrode spacing) equals 10 ft., the resistivity obtained with the formula represents an average of all material present below the ground surface to a depth of 10 ft. As the electrode spacing is increased the current flow lines extend to deeper layers in the earth's crust.

"When using the empirical method of interpretation proposed by Gish

*Ibid., p. 52, 53.



★ Figure 1.—Diagrammatic explanation of operating principle of the electrical resistivity equipment. After Moore: "Fundamental Principles of the Earth-Resistivity Method."



★ Another view of the resistivity equipment set up in the field.

and Rooney* the apparent resistivity ρ_a , obtained by inserting the measured values of A, E, and I from the field tests in the formula for resistivity as given above, is plotted as the ordinate against the electrode spacing A as the abscissa. The inflections in the resulting curve are interpreted as indicating changes in the materials underlying the surface."

Other methods of analysis of earth-resistivity data both empirical and based on theoretical studies have been used but the method above cited by Moore suffices for illustration.

Traverse surveys often called "constant depth traverses" are also used. Moore states: "In this, a succession of tests using a fixed electrode spacing are made along the selected traverse line, the interval between test sites being equal to the electrode spacing.

*Gish, O. H.: Improved Equipment for Measuring Earth-Current Potentials and Earth-Resistivity. National Research Council Bulletin, Nov., 1926, Vol. 11, pt. 2, No. 58, p. 86.

The measured resistivity values are then plotted as ordinates against traverse distances as abscissas, and the resulting graph shows the variation in resistivity along the traverse line for a depth equal to the electrode spacing chosen." Such traverses are valuable in locating isolated deposits of granular material or rock in areas where such materials are scarce or not apparent on a visual examination of the ground.

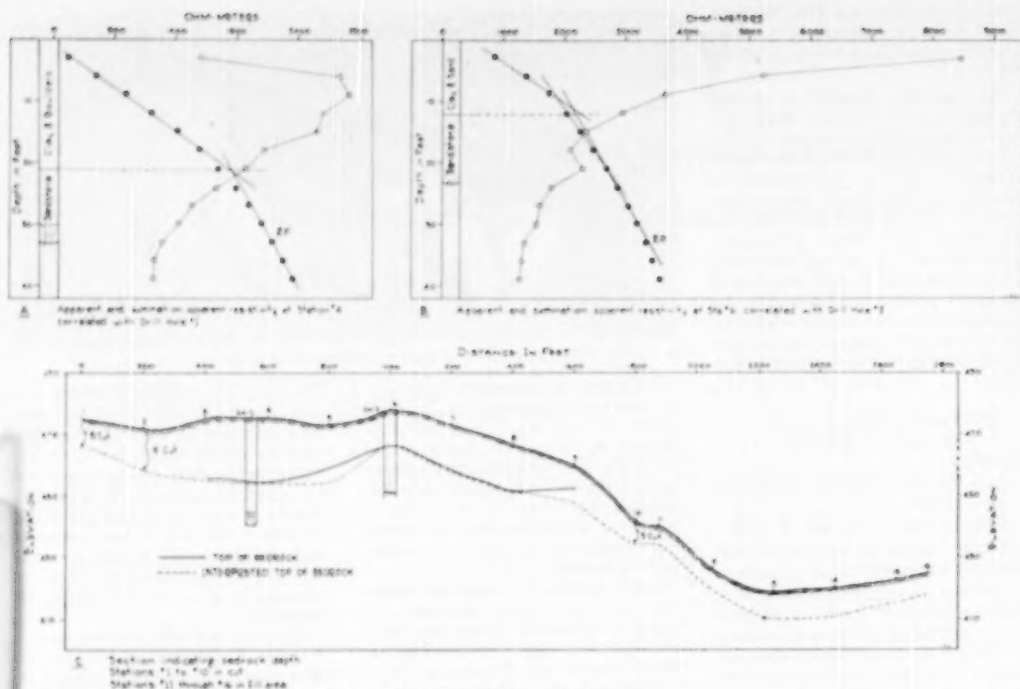
In prosecuting these studies on the Turnpike Extensions, electrical resistivity measurements using the Gish Rooney type ground resistivity meter and the Wenner electrode configuration were made at 100-ft. intervals in the many cuts. Apparent and summation apparent resistivities have been computed and profiles drawn which served as a basis for interpretations to bedrock. See Fig. 2.

The depth to which the resistivities were determined varied in accordance with the maximum depth of the proposed cut. The depth measuring interval (electrode spacing) was 1½ ft. down to 12 ft. in depth after which it was increased to 3 ft. Any interpretation even if 100% correct, is subject to a plus or minus correction equal to the measuring interval involved. The depth measuring interval of 1½ ft. was used because the mantle or overburden on the bedrock in much of the Turnpike area is very thin.

Field Equipment and Methods

The basic field equipment is usually boxed in two pieces, the potentiometer, milliammeter and pertinent parts in one box; the battery in a second. In addition the steel pin electrodes, wire reels, clips, short-handled sledge or maul, and small tools must be carried. Sometimes small reels attached to the principal instrument case simplify handling. Generally, however, the four reels are carried individually.

It is important to seat the principal instrument case on a firm box. A shaky



★ Figure 2. Application of electrical resistivity method correlated with core borings.

tool vibrating during commutation of the instrument may affect the galvanometer and introduce an error in the meter readings. It is also important to make sure the pin electrodes are firmly driven into the ground for a loose "seating", too, may introduce an error in the reading.

Instrument setups and pin seatings should not be made adjacent to steel pipes, rails or other steel objects which can introduce stray currents and also cause errors to creep into the readings.

Measurements should not be made in thawing ground or immediately after a heavy rain or dew.

The field party is relatively small. The instrument man is the key figure in the group. He operates the instrument, determines the current used in milliamperes and reads the potential. He directs the activities of the field party. Generally four laborers are used. They set the steel electrode pins, handle the wire and cut brush. Because of the paper work involved there is usually a man back in the office. He also does the computing and plotting of the data.

Final interpretation is done by a qualified geophysicist. He must have a knowledge of geology and geologic structure in order to understand the geophysical findings and translate them into terms that can be understood by the engineer.

The rate of progress of an electrical resistivity survey is dependent on such variable factors as the nature of the terrain, and the thickness of the overburden. Obviously it takes much less time to measure the thickness of the mantle to a depth of 5 ft. than it does to 50 ft. A competent field party may be expected to measure 20 stations a day to a depth of 25 ft., using a 3-ft. electrode spacing. Another way of indicating a reasonable rate of progress is to assume we have a proposed highway cut 2000 ft. long which will be excavated to a maximum depth of 20 ft. By establishing stations and taking a depth measurement to 25 ft. at 50 ft. intervals the survey of this cut could be completed in two days. Compare this with the speed of core borings.

Importance of Geological Check Data

The importance of check data supplied through the medium of core borings cannot be overemphasized. The electrical resistivity method by itself cannot discriminate between different types of shales, sandstones, etc. The sandstone might be thin-bedded or platy, and yet without a check bore hole the geophysicist could not differentiate it from a massive or thick bedded sandstone. The importance of this knowledge to a contractor, how-

ever, is very great because it influences the type of excavating equipment he must use, the amount of dynamite and other materials that will be required.

In all of the principal Turnpike cuts one or more check bore holes were drilled. These were all of the standard type giving a 2½ in. core. All drill rigs were portable (on skids) but not truck mounted. Continuous samples were taken with standard sample spoons to the top of bedrock after which diamond cores were taken through the rock to a depth of at least 5 ft. below final grade. The hammer weight, drop in inches, and spoon diameter were recorded and the blows noted for every foot of penetration. The samples were taken "in front" of the casing which was advanced after the ground had been sampled about 5 ft. below the casing. In caving ground the casing was advanced more rapidly. The position of the ground water table and such migrant water as was encountered above it, and/or water losses, were recorded. Upon the completion of a bore hole the water level in the hole was given a final check.

Upon the completion of the geological and geophysical studies, reports were prepared on each section of the new Turnpike extensions. In these a correlation was made between the bor-

ings and geophysical data. Such reports were made available to the contractor.

Accuracy of Electrical Resistivity Method

The accuracy tolerance of the electrical resistivity method in determining overburden thickness, as demonstrated in the first 104 cut sections (some now excavated and all checked by core boring data) is approximately 1.88 ft. This figure averaged less than the allowable error determined by the electrode spacing. Such accuracy, in effect, takes the gamble out of bidding on "common" excavation for the contractor, and is reflected in a low bid price with consequent saving to the "owner."

Method's Limitations

When topsoil is underlain by a massive bedded limestone or a massive igneous rock the curve "break" plotted from resistivity readings is very sharp. On the other hand, firm shale rock may occur under inches or feet of the same material which is largely decomposed, in part residual soil and in part shale fragments. It has been observed that the top of bedrock over certain shales, as indicated by resistivity measurements, is often indicated at the point of contact between the true soil and the firm weathered fragments of shale. Actually this "weathered" shale zone can be handled by the

contractor the same as a loose soil and would not have to be drilled and shot. This example is a good illustration of the importance of check core borings for the purpose of determining the top of solid rock. Many arguments can arise over "when is rock not rock." In the case of such a shale as cited above, even the geophysical equipment can be wrong. For ordinary purposes we interpret "bedrock" as hard or firm, compact rock, which cannot be removed without recourse to blasting except in those instances where its bedding or fracture system lend it to removal by power shovel or rooters.

Unsatisfactory results were obtained in a limestone area where the crystalline limestone strata dipped approximately 65 degrees from the horizontal. These strata varied greatly in solubility, hence a particular layer might crop at the ground surface, but a few feet distant another 3 or 6 ft. stratum might have weathered into a residual soil to a depth of many feet.

Examples were found where these vertical differences were as much as 20 and 40 ft. If these deeply weathered and soluble beds are closely spaced and the line of electrode spacings are normal to their strike, the precise thickness of the residuum over the soluble layer is not ascertained. Only when the line of electrode spacings is parallel to such "ridges" and "troughs" would the true depth be determined. A preliminary geological

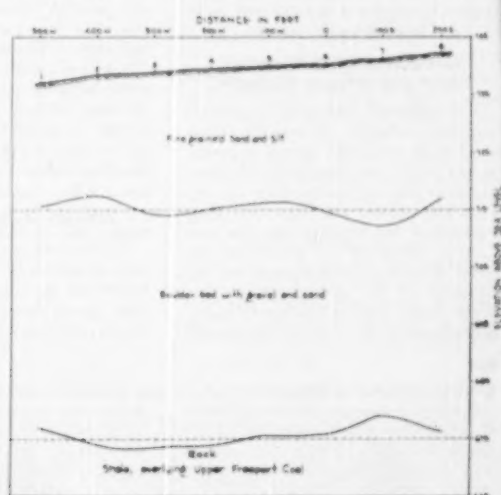
reconnaissance by a competent man would usually reveal the possibility of such a condition and key core borings would confirm it.

A Special Instance

Another unsatisfactory result was obtained over a diabase, igneous rock area. Here, in the geologic past, diabase had been injected, while in a liquid state, into a series of interbedded shales and sandstones. The diabase occurred in several layers varying from about 3 ft. to 12 ft. in thickness. They were present in a conformable sequence between the enclosing sedimentary rock. Some of the diabase layers cooled faster than others; consequently the grain size varied. The faster an igneous rock cools the finer the grain size and vice versa. Over a long stretch of geologic time these rocks became reexposed at the earth's surface and were weathered. The diabase has weathered more severely and deeply than the enclosing sedimentary rock. Today much of the diabase exists as a "relic" soil (decayed in place). However, within this "relic" soil there are unreduced remnants of solid diabase. These occur as cupolas and enormous boulders and slabs. Furthermore, because some of the diabase was coarse-grained and some fine-grained, the moisture content within their residual soils is extremely variable. These factors gave misleading resistivity information



A. Correlation of test boring and resistivity profiles.



B. Vertical geologic section on line of resistivity stations.

★ Figure 3. Electrical resistivity measurements and test boring correlation on sand bar in Allegheny River; Pennsylvania Turnpike western extension.

which made correct field interpretations difficult. If the igneous diabase had been all a part of one great intrusion into the earth's crust it would have given much more reliable readings.

Difficulty was also experienced in sinkhole areas. Here caved roof rock concealed by overburden frequently masked the actual subsurface condition. Unless the ground surface was depressed a resistivity measurement might fail to show the extent of the true condition. Large sinks can be determined but small ones with only solution channels of limited diameter "breaking" through to the surface could not be spotted by resistivity methods. However, a correlation of the known sink-hole areas with our resistivity profiles showed that in every case where the limestone stood high above the general limestone elevation the sinks occurred in the high areas. This was probably a local phenomenon but this approach proved helpful on the Philadelphia Extension.

These examples illustrate some of the limitations. Such conditions were fortunately in the minority and generally the geophysical data were reliable and accurate to a degree beyond expectations. This was true not only in the area of the Western Extension on the Allegheny Plateau where the flat-lying sedimentary rock strata belong in the coal measures, but also in the folded, metamorphosed and intruded sedimentary and igneous rocks of the Philadelphia Extension.

Successful in Delineating Sand and Gravel Deposits

The electrical resistivity method is especially effective in making rapid surveys of sand and gravel deposits, or any other loose granular materials useful in highway construction. In one Turnpike section burning culm piles occurred in the right-of-way. Because it was necessary to determine the depth of some of these mounds and the elevation of the natural ground beneath them, several resistivity depth measurements were made. Subsequent

excavation showed that this method had given the correct depth within 6 inches.

In connection with the investigations for the Turnpike's Allegheny River Bridge, resistivity depth measurements were made on Fourteen Mile Island, near the middle of the river (Fig. 3). A core boring was made in the center of this island on Turnpike centerline. This record is exact and sand, gravel and rock contacts were plainly delineated. Eight resistivity stations were located in the vicinity of the bore hole. These had the electrode configuration extending parallel to and normal to Turnpike centerline. The profiles at station No. 6 (Fig. 3-A) are shown correlated with the bore hole drill log. Very definite breaks on the resistivity profiles correlated precisely with horizons shown on the drill log. On the basis of the bore hole and the resistivity depth measurements a geological section was made along the line of resistivity stations showing the distribution of these sands, gravels, and the top of solid bedrock (Fig. 3-B).

Conclusions

The application of the electrical resistivity method for determinations of the "top of rock" in cuts and at the sites of proposed bridges and drainage structures on the Pennsylvania Turnpike Extensions has been very successful. Not only were the numbers of core borings reduced but much valuable time was gained because of the rapidity of this method.

A grand total of 245 proposed cuts were surveyed by this means and of the 104 checked for this paper the margin of error was 1.88 feet. This figure will probably be reduced when the final check is made because those areas where unusual conditions existed, such as the diabase and sinkhole areas, were included.

It should be clearly understood that this geophysical method is not an "end" tool by itself but for best results should be checked with key bore holes. Furthermore, the importance

of competent interpretation cannot be overemphasized. For this purpose a man thoroughly trained in theory and practice is essential. A knowledge of geologic principles and geologic structure is also vital inasmuch as these factors are definitely reflected in the accuracy of interpretation. The use of partially trained personnel and amateurs could swiftly bring the use of this valuable technique into disrepute.

Longest Bridge in New England. The Mystic River Bridge at Boston, Mass., opened to traffic in February, is the longest in New England and third longest in the United States. It extends a little over two miles from the Charlestown area to Chelsea. The bridge has seven traffic lanes and a water clearance of 135 ft. It was built for the Mystic River Bridge Authority, and the cost was \$27,000,000, of which the first year's toll is expected to return \$1,982,000. J. E. Greiner Co. was the designing engineer.

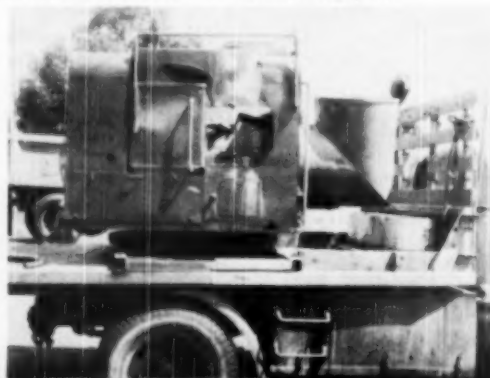
Safety Device for Maintenance Unit

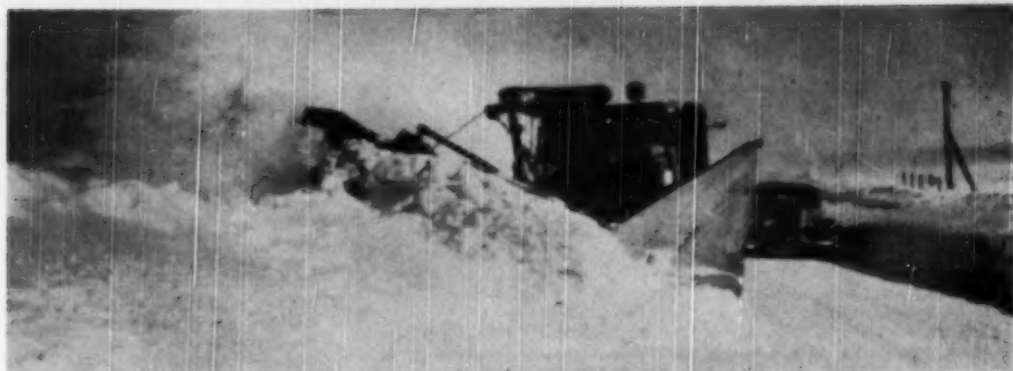
Here is a pair of "before and after" pictures, showing how the Connecticut state highway shop employees fixed up one of the maintenance department's machines to make it safer for the operator.

The machine is a mist blower, used in weed control, etc. Before the alterations were made the driver's seat was a hazardous part of the world, where he perched without a chance to hold on to anything. The safety improvements include a new welded handrail on either side of the seat, nonskid step, body guard, and a rear flasher light (latter not shown). The property control division of the highway department is credited with these betterments, encouraged as part of a program to keep worker accidents to a minimum.

58

★ Before and after installing guard rails and other devices to make the driver's seat of this machine a safer place





★ Most of Houghton County's plow trucks are equipped with V-units plus one or two wings.

PLOWING METHODS FOR Very Heavy Snowfall

Record snowfall of 282.6 inches last winter spotlighted Upper Michigan County's problem of keeping greater mileage open with funds already stretched to the breaking point.

By Carl F. Winkler

County Highway Engineer, Houghton
County, Michigan

SNOW removal methods in the Upper Peninsula's copper country are tailored to fit our particular needs. They come from experience gained in this region by trial and error, by studying the methods of others, and by observing and sometimes trying out each new piece of equipment as it is developed. Operator training on the job is especially important—each man is trained in the methods which have been found to best fit our needs.

Snow removal is very difficult and expensive because of unique geographical, meteorological and local conditions. The hilly Keweenaw Peninsula reaching 60 miles into Lake Superior catches moisture-laden lake winds. Over the past 60 years the normal snowfall is 160 inches annually, with occasional winters of more than 200 inches. Last winter's fall was 282.6 inches—a new record and 25% over the highest previous total.

Depth of snowfall, however, isn't the chief cause of our trouble. It is wind. Our entire county is more exposed to winter winds than formerly, due to

lumbering operations. The hilly terrain, with elevations up to 700 ft. above Lake Superior, add to the problem. Drifts 10 to 15 ft. deep are common, and snow reaching to second story windows is not infrequent. The snow blanket in protected areas lies 3 to 6 ft. deep.

Special Equipment Needed

Our basic need is to have sufficient equipment of the right kind to cope with severe and quickly successive storms, and do so promptly and efficiently. Our equipment must be so heavy and powerful that conversion of summertime hauling equipment is not the answer. Use of all-wheel-drive snow trucks in summer for graveling, for example, is considered too costly. These trucks are saved mainly for winter while lighter trucks do most

of the summer maintenance work. We find that this policy results in the most economical and efficient year-around road service.

Elsewhere in the U. S. from year to year one reads of disastrous snowstorms, which catch officials without proper facilities because of normally mild winters. Equipment is pressed into emergency service regardless of its fitness for snow work, and the results are extremely costly and unsatisfactory to the public. During such emergencies, new equipment is often bought without planning or forethought.

My answer is that, throughout the snow belts, proper equipment should be available. It should be reserved for snow clearing and kept stored in readiness for this task, for years if need be. When a big storm comes, this policy will pay off.

We begin plowing as soon as a light fall of snow begins to make travel difficult. Our specialized equipment is heavier than needed at first. But the power under the hood, and the wide

Annual Snowfall in Upper Michigan—Getting Heavier!

(Data for Houghton County)

1896	9.0 ft.	1920	9.8 ft.	1945	18.6 ft.
1895	11.9 "	1925	7.0 "	1946	16.0 "
1900	8.0 "	1930	12.0 "	1947	15.0 "
1905	11.0 "	1932	8.0 "	1948	15.0 "
1910	11.0 "	1935	17.0 "	1949	16.0 "
1915	11.5 "	1940	14.0 "	1950	24.0 "
Average for Period 10.2 ft.		Average for Period 10.3 ft.		Average for Period 17.3 ft.	



★ March, 1950—Walter trucks with wings and V-plows are clearing encrusted snow from farm-to-market road. Deep drifts and extreme hardness of snow required one and sometimes two units pushing load plow to cut banks.



★ Roto Wing equipped truck at work daylighting a deep cut.

cuts with plow and wings, make this phase of the job fast and efficient. As winter snows deepen, the equipment pays off in dependability.

Some of Our Methods

Plow trucks are given definite routes and kept there as much as possible. But drivers need to be familiar with all the roads in an area, in case of breakdowns and re-routing. Whenever possible 100% of trunk lines are kept

open. As a storm increases in intensity lesser roads are abandoned and reopened as soon as better visibility returns.

Nearly all snow plows are standard "V" type with 10-ft. cutting edges. Although we have a few one-way plows their use has largely been eliminated. One-way plows are efficient up to a point, but can get stuck in heavy going. "V" plow cutting edges vary in height at nose and delivery point, ac-

ording to the truck used. "V's" are commonly used with a side or leveling wing 10 to 14 ft. long, which is hydraulically controlled, this equipment being able to move as much snow and throw it about as far as a one-way plow while scraping more roadway width. A "V" plow with wing is good for 16 to 18 ft. of width on the first pass, or twice the width of a one-way plow. And coming back on the other side it will add another 10 ft. to the plowed surface.

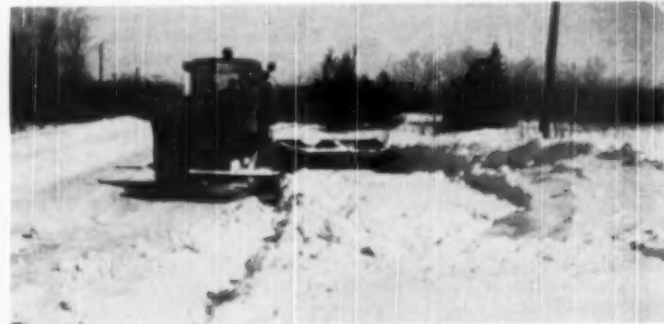
Both right and left wings are used on some trucks, enabling the operator to clear the entire roadway on a single trip through. From careful training the driver learns to watch for on-coming vehicles and raise one or both hydraulic wings quickly, and thus avoid traffic hazard or inconvenience.

Drifting is our chief problem, due to the depth of fall and the fact that the wind shifts from east to west during nearly every storm. A 10-in. snow-fall without wind could be cleared easily and quickly; with wind, it customarily means days of continuous plowing and re-plowing. In fact, plowing in the county is continued practically without let-up, and lulls are used to clean up, widen and eliminate high windrows.

Prevention of building up of high banks is vitally important because of the rapid succession of storms. Drivers keep down banks by setting their wings and "V" plows carefully to get maximum dispersal, and by judicious use of leveling wings so that snow is not pushed too high. Operators are educated to the importance of this phase of the work, which can make the difference between success and failure in coping with successive drifting.

8-ft. Snow Fence

Despite all precautions, however, banks eventually get too high in many places for proper delivery of snow from the outer edge of the mold board. High banks are minimized by the use of snow fences. About 300,000 ft. of



★ Motor graders with V apron, wing or both, are used to cut down banks and for other special duties—see article. View at right shows bank cutting (Caterpillar graders).



★ Crawler tractors with bulldozer or plow apron served to open up trails, farm entrances, etc. (Photo courtesy Caterpillar Tractor Company)



★ Who backs up and who goes ahead? A 15-ft. drift cut just completed, but before rotary plow has had time to widen it to two lanes. Such cuts required repeated plowing during storms.

standard 4-ft. high fence is used. For narrow right-of-way or exceptionally severe drifting, about 10,000 ft. of two-high fence is set, using special longer steel posts. This is more efficient than a double row of 4-ft. fence.

In some places we have used roadside land with permission to erect two lines of 4-ft or 8-ft. fence permanently. Fence is suspended from galvanized wire rope between cedar posts. About 25,000 ft. of such installations are in service, and they are expected to last 15 or 20 years or longer.

In a normal winter rotary plows, of which we have eight, will be kept employed continuously. Their chief function is to widen plow openings to full width, and they are concentrated in high drifts. Despite their slow travel speed they move enormous tonnages, and are indispensable where snow has begun to pack down. Snow as dense as 30 lb. per cu. ft. occurs through wind movement and packing by plows. Toward spring much snow becomes almost like ice.

Following rotary widening, leveling wings are used to cut down the upper 2 or 3 feet of the bank and thus reduce future snow trapping. Rotaries work between storms, and mostly during daylight. After a very severe storm a rotary is often sent along behind a "V" plow, for cutting around the plow should it get stuck. Rotaries also are sent to open roads drifted too high for displacement plows.

Motor Grader Use

Motor graders with "V" plows and side wings also help with snow removal. These units, traveling almost as fast as trucks, can clear trunk line surfaces, including shoulders, in a single trip when snow is light. Smaller graders are also pressed into service at times. The special province of graders is the clearing of snow mat down to the bare pavement, as demanded by road users today on arterial roads.

Heavy motor graders perform invaluable service in late winter, by sleighing down softened bank masses into the roadway for disposal by ro-

taries. For this job the side wing is reversed, and the grader is towed by one of the larger trucks, making for better grader steering control and

maximum speed and volume of work. Two rotaries, moving rapidly through the loose material, make good time throwing it out. Or a "V" plow truck

Houghton County's Tale of Woe— See Tabulation of Equipment on Next Page

August 7, 1950

To the Honorable Board of
Supervisors
Houghton County
Houghton, Michigan
Gentlemen:

We are submitting to you herewith again a list of maintenance machines now in use. The list shows the name of the machine, its type, year, model, length of years in use, present condition, the cost when new and its present replacement cost.

As can readily be seen, the entire fleet of automotive maintenance equipment has long ago outlived its useful life and should have been replaced. Replacement, however, was impossible, due to five years of war restriction and to continued lack of finances, this lack of finances being more acute each year until at present any purchases are out of the question entirely.

Since it requires a certain number of units to cover the county, all equipment has been kept in repair and used in spite of its obsolescence and in spite of the fact that maintenance thereof is, and has been, excessive. However, if equipment cannot be renewed and if the work requires to be done, it becomes imperative to keep the old machines going.

In this day of advancement all machines have been improved. Work to be of reasonable cost, efficient and timely requires modern tools, be it in the factory, on the farm, in the mine, or on the

roads. Results cannot be satisfactory if proper equipment is not available, regardless of management, skill and willingness of workers.

We trust that your Board of Supervisors will study this list and from such study determine for yourselves the adequacy of the tools available to the Road Commission to keep in repair and to reconstruct the 900 miles of county road.

The three additional mills voted by the County for five years and limited by your Board to three mills for two years and one mill for the coming year, did replace as promised, but *did not add* one single unit to the snow removal fleet. Therefore these units, which were not renewed and which at the time were from one to ten years old, are now three years older and some, consequently, have seen more than ten years of gruelling service.

The list shows that it will require almost \$600,000 to replace worn and obsolete equipment; so that even if \$100,000 additional per year should be made available, it would require six years to renew the present aged and dilapidated fleet, while the units waiting replacement would continue to wear, put on age and become nearer and nearer to becoming museum pieces rather than tools for desirable work results.

—C. F. Winkler
County Highway Engineer.

Houghton County's Equipment—Much Needs Replacing

Unit No.	Make	Year Made	Year Purchased	Years Old	Condition	Price Paid	Price To Replace
114	Studebaker	1935	1935	15	Fair	\$1,030.00	\$1,800.00
116	Dodge	1936	1937	14	Fair	1,000.00	2,000.00
129	Dodge	1940	1940	6	Fair	2,100.00	3,600.00
227	G.M.C.	1931	1940	19	Fair	2,700.00	4,800.00
125	Marmon-Herrington	1939	1940	11	Fair	2,198.00	4,500.00
306	Marmon-Herrington	1939	1940	11	Fair	2,198.00	4,500.00
221	White	1932	1932	18	Bad	7,315.25	8,500.00
215	White	1934	1934	16	Bad	7,258.69	8,500.00
235	F.W.D.	1935	1946	15	Fair	1,200.00	12,000.00
277	F.W.D.	1935	1947	15	Good		12,000.00
226	Autocar	1937	1940	13	Fair	3,750.00	16,000.00
720	Walters	1936	1936	14	Fair	9,100.00	16,000.00
721	Walters	1937	1937	13	Fair	9,300.00	16,000.00
723	Walters	1937	1937	13	Fair	9,750.00	16,000.00
724	Walters	1937	1937	13	Fair	9,750.00	16,000.00
TRACTORS							
409	Cat. #50	1935	1935	15	Bad	4,625.00	7,200.00
GRADERS							
514	Caterpillar	1938	1940	12	Fair	5,500.00	11,198.20
505	Russell	1931	1931	19	Bad	3,815.00	6,500.00
507	Adams	1931	1931	19	Bad	2,962.00	6,500.00
508	Adams	1935	1935	15	Bad	3,214.00	6,500.00
509	Caterpillar	1935	1935	15	Bad	4,812.94	6,500.00
510	Caterpillar	1935	1937	15	Bad	4,500.00	6,500.00
512	Adams	1937	1938	13	Bad	3,700.00	6,500.00
513	Caterpillar	1937	1939	13	Fair	1,857.50	6,500.00
516	Adams	1935	1941	15	Bad	1,007.15	6,500.00
517	Caterpillar	1931	1944	19	Fair	2,650.00	6,500.00
518	Caterpillar	1931	1944	19	Fair	2,650.00	6,500.00
521	Caterpillar	1931	1944	19	Fair	750.00	6,500.00
SHOVELS							
701	Ray City	1927	1928	23	Junk	6,053.50	11,000.00
702	Northwest	1928	1931	27	Last this yr.	7,500.00	18,000.00
705	Spencer	1940	1940	10	Fair	6,000.00	11,000.00
708	Spencer	1934	1939	16	Bad	4,036.60	13,000.00
720	Michigan	1934	1941	16	Junk	3,500.00	11,000.00
711	Air Compressor	1940	1940	10	Good	500.00	2,800.00
801	Distributor-Genl.	1928	1930	22	Bad	3,229.25	5,000.00
803	Distributor-Rosc.	1930	1948	20	Bad	740.93	4,500.00
TRUCKS							
410	Klauer	1936	1936	14	Fair	10,169.17	12,400.00
213	F.W.D.	1932	1932	18		8,200.00	14,000.00
611	Klauer	1936	1937	14	Fair	17,156.64	12,400.00
218	F.W.D.	1936	1936	14		7,000.00	14,000.00
612	Klauer	1936	1938	14	Fair	14,978.56	12,400.00
222	F.W.D.	1937	1937	13	TRUCK	6,280.00	14,000.00
613	Klauer	1936	1939	14	Fair		12,400.00
	F.W.D.	1928	1929	22			14,000.00
614	Klauer	1936	1939	14	Fair	14,295.00	12,400.00
216	F.W.D.	1936	1936	16	TRUCK	7,388.00	14,000.00
615	Klauer	1940	1940	10	Fair	9,500.00	12,400.00
222	Walters	1927	1928	23			13,000.00
616	Klauer	1932	1932	18	Obsolete	11,500.00	12,400.00
619	Klauer	1934	1934	16	Obsolete	10,498.00	12,400.00

*Obsolete - would need two trucks additional-Cost
 *bought as second hand equipment
 *allow using the second truck under Shovel

Total - - - \$525,700.00

with 250-hp. motor can often move through the rotting material fast enough to throw it well over the fences.

Crawler tractors are not used for our main plowing work, since their use tends to aggravate snow trapping conditions during quickly successive storms. Late in the spring when conditions are milder, plow or dozer equipped tractor units do come into play for opening up trails, etc.

Recent Fleet Additions

During 1948 and 1949 the County invested \$225,000 in new heavy snow fighting equipment. The principal units include the following:

- 2 Marmon-Herrington all-wheel-drive trucks of 28,000 lb. gross vehicle weight.
- 2 FWD all-wh.-dr. trucks, 28,000 lb. gross vehicle weight, equipped with wings on one side.
- 4 Walter all-wh.-dr. trucks, equipped with 275 hp. motors and double side wings on both sides.
- 3 Oshkosh all-wh.-dr. trucks, 33,000 lb., wings on one side.
- 1 used Walter truck.
- 2 Roto Wing units.

Special comment is made on the Roto Wing units. We bought one for the 1948-49 winter, and it gave such excellent service in keeping down average banks that a second unit was added the following year.

The above-named units constitute the bulk of new road equipment purchased in Houghton County during the past few years. Another \$600,000 needs to be invested in replacement of the remainder of our units, most of which are 10 to 20 years old.

However, counting old units and new, the County last winter had 23 all-wheel-drive trucks, 16 motor graders, 41 "V" plows and 21 wings—all-wheel-drive trucks include Walters, FWD, Oshkosh, Marmon-Herrington and Auto Car. The heaviest of these trucks are powered with Waukesha diesel motors ranging up to 275 hp.

And well that this equipment was on hand. The winter was the severest ever experienced, in both snowfall and spring break-up. Beginning early in January storms followed storms without let-up until late March.

Need More Funds

The road mileage plowed by the Houghton County force has increased over 200 miles in recent years, in response to demands of schools, industries and citizens generally. We now plow 850 miles including 112 miles of state trunk lines under contract with the state highway department. School bus routes, alone, would necessitate keeping the full mileage cleared.

I could dwell at great length on our road problem, which is an acute one in all Michigan due to serious lack of funds to meet increased obligations, and doubly serious in upper Michigan because of snow costs. Suffice it to say that summer work today is confined largely to maintenance, and skimpy maintenance at that, in order to finance snow removal.

One need in Upper Michigan is for better coordination of snow plowing between the various counties. Inter-county travel today is essential to the public welfare, and will become increasingly so if our military activity heightens.

Meantime our big job is to maintain a good equipment fleet and, behind that, to keep up our organization. Our employees must be qualified, experienced, and physically able to fight storms; a good snow plow operator is more than just a truck driver. And our men must and do feel proud of their work and believe in the public importance of their service.

AASHO Issues Proceedings

Proceedings have been published by the American Association of State Highway Officials, covering many of the important papers given at the San Antonio Convention in October, 1949. No free distribution planned. Copies available at \$4.00, according to Hal H. Hale, AASHO secretary. Send remittance to the above Association, 1220 National Press Bldg., Washington, D.C.

Navy Calls for Skilled Construction Men

Last minute news from the U. S. Navy points out that skilled construction men can still enlist in the Naval Reserve as Seabees and receive petty officer ratings equal to their civilian experience.

By joining the Seabee Volunteer Reserve, older men in the construction trades not only will retain their rating when and if they are called to active duty, but they also will have reasonable assurance that they will be assigned to Naval Construction Battalions for high speed building and defense of overseas bases.

The seven Seabee ratings open cover some 60 different civilian construction skills. These ratings are: Builder, Mechanic, Steelworker, Utilities Man, Construction Electrician, Driver, and Surveyor. Volunteers will be placed on inactive duty, with no drills or required meetings. They may be called to active duty when required.

Enlistment in the Volunteer Reserve is limited to men who have reached their 26th birthday but not their 45th. The upper age limit is extended in case of veterans to the same number of years beyond age 44 as their previous military service. If this previous service has been with the naval service, volunteers will be accepted up to age 50½ years, plus the number of years of naval service.

Depending on the kind and amount of civilian experience, skilled construction men can expect to be rated at some point in the scale between Chief Petty Officer, with minimum active duty base pay of \$198.45 per month, to Third Class Petty Officer, with a minimum of \$117.60. Additional pay is given for dependents and for years of previous service.

Those desiring to volunteer should get in touch with the Commanding Officer of any Organized Reserve Construction Battalion Company or Volunteer Construction Battalion Reserve Unit. These are located in more than 300 principal cities throughout the country. Application also can be made at any Naval Recruiting Station.

Bituminous Roads and Streets

Section begins on page 83. Turn to this Section each month for timely articles on design, construction, maintenance, materials, testing, research.

FASTER BETTER SOIL COMPACTION



JACKSON

Specified densities are quickly reached in granular soils with the Jackson Vibratory Soil Compactor. For those areas adjacent to structures, bridges, culverts, trenches, factory floors and earth fill dam construction there is nothing that begins to equal the Jackson Compactor for speed, convenience and thoroughness of compaction. Self-propelling, the operator merely guides it. Send us a sieve analysis or small sample of the soil and we will tell you what you can expect in percentage of A.A.S.H.O. densities and depth of compaction.

MOST PRODUCTIVE OF ALL SCREEDS

for

BRIDGE DECKS
ROAD WIDENING
MUNICIPAL PAVING
ALLEY PAVING
HIGHWAY PATCHING
and OTHER JOBS



CROWNS—(Any Type)—INVERTS—UNDERCUTS

With the Jackson electric Vibratory Hand Screed (powered by a Jackson 1.25 KVA Portable Power Plant) it is possible to eliminate center construction joints and pour full widths up to 30 ft. And it is the only screed that can be rolled back (on 4 rollers) for second passes. Screed is furnished with all hardware, cable, shoes, rollers and vibratory motor attached to an 8 ft. plank. The contractor has only to provide himself with a plank of suitable length, specified crown, and then transfer the hardware to be set for any particular use. Screed has strong tendency to propel itself forward and requires only two men on any width slab.

FOR SALE OR RENT

The above equipment as well as many other time and money-saving Jackson vibrators are for sale or rent at your Jackson Distributor. See them there or write for handy "POCKET GUIDE" to the Jackson line.

ELECTRIC TAMPER & EQUIPMENT CO. Ludington, Mich.

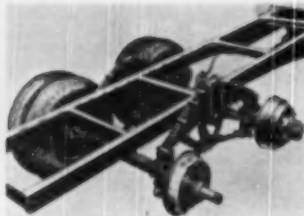
NEW EQUIPMENT AND MATERIALS

New and Improved Construction Projects

Additional facts on products described below can be obtained from the manufacturer via postcard inserted at page 74. Each item is numbered. Just circle the corresponding number on the card and mail.

1 Axles Increase Truck Capacity

A new heavier model for use with 2 to 6 ton trucks has been added to the line of trailing axles for increasing truck capacity by Little Giant Products, Inc., Peoria, Ill. Designed as the Model "D",



Model D Trailing Axle.

the new trailing axle's heavier axle and springs will offer an 18,000 lb. capacity. Its heavier construction features include: A 3½ in. square axle of heat treated chrome-nickel steel, 21-leaf springs, hydraulic or air brakes, wheels interchangeable with the truck, with 11.00 tires recommended.

WAUSAU SNOW PLOWS

FOR OVER A QUARTER CENTURY

The WAUSAU IRON WORKS has concentrated its full efforts and engineering skill toward one objective — BUILDING THE BEST SNOW PLOWS AND SNOW WINGS IN THE WORLD.

Today, as in the days when WAUSAU and its dealers helped far-seeing Public Officials pioneer the idea of snow removal, the name WAUSAU on a snow plow is the symbol of quality backed by these proven features of superiority in construction and design:

● MOLDBOARDS

- Alloy steel for strength.
- Rolled smooth for less resistance.
- Adjustable for pitch.
- Spring mounted deflectors.
- Adjustable and oscillating shoes.
- Level Lift.

● HITCH

- Tailored to truck to distribute weight and stress.
- 4 or 6 point push using Wausau's exclusive toggle.
- Chafing for side thrust.
- Vee and One-way interchangeable.

A size and shape for every need on every type of motive power from light weight speed plows to the Largest Heavy Duty plows which use plate deck plus riveted and welded construction with truck frame chafing.

Sold and Serviced By Leading Equipment Distributors

WAUSAU IRON WORKS

Pioneer Snow Plow Builders

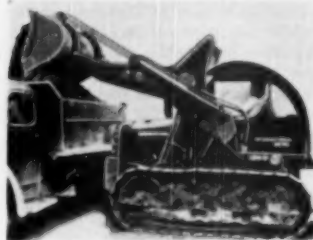
WAUSAU, WISCONSIN



WRITE FOR
FURTHER
INFORMATION

2 Tractor Shovel

A new 1-yd. combination overhead loading and front end loading tractor shovel for International crawler tractor is now being produced by Service Supply Corporation, Philadelphia, Pa. Developed after five years of field studies and testing, the new unit is stated to substantially increase loading production because turns are eliminated. Elimination of



Lodover Tractor Shovel.

turns plus low overhead clearance are stated to permit the unit to operate effectively in highly restricted quarters, in mines and on streets with heavy traffic and under overhead obstructions. Extra digging power at the bucket, plus special bucket tilt-back at ground level are claimed to produce exceptional digging and bucket-filling ability. A large number of useful attachments are available including a hydraulic dozer blade mounted inside the tracks, a hydraulic angle blade, lift fork for pallet and skid loading attachment, rear-mounted winch, crane boom (10,000 lb. capacity), snow-bucket, V-type snow plow, and a track cleaning bucket for railroad work.

3 Earthmoving Equipment

Early production of two new high-speed, long haul and high-capacity earthmoving machines has been announced by Caterpillar Tractor Co., Peoria, Ill. The new units, a four-wheel diesel tractor-wagon combination, the "Cat" DW20 tractor with W20 wagon; and the powerful 2-wheel diesel prime mover, the "Cat" DW21 equipped with the No. 21 scraper, are scheduled for production late this fall. These two new machines are the result of five years of intensive research, design engineering and job-



"Cat" DW20 with W20 Wagon.

proved application. In addition to the W20 wagon, the 4-wheel DW20 tractor will also be available with a No. 20 Scraper and a No. 20S Bulldozer. The new No. 27 rear double-drum cable control unit will be offered to operate the bulldozer. Both the DW20 and DW21 prime movers have the new six-cylinder "Cat" diesel engine rated at 275 hp



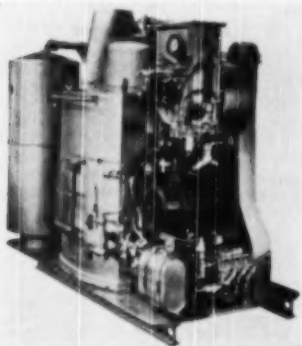
"Cat" DW21 with No. 21 Scraper.

peak capacity @ 2000 r.p.m. and 225 hp @ 1900 r.p.m. available at the flywheel. The new engine has a 5 1/2 x 6 in. bore and stroke with 743 cu. in. piston displacement. A governor is provided to control low idle speeds and to prevent over-speeding of the engine. All working speeds are controlled by means of a foot throttle.

4

Steam Generator

A new portable vapor steam generator which supplies large quantities of high pressure steam for short or sustained periods for pile driving, asphalt plants, etc., has been announced by Vapor Heating Corporation, Chicago, Ill. The machine is stated to develop 200 lb. work-



Vapor Steam Generator Model 4635.

ing steam pressure in two minutes from cold water and to make over 3,500 lb. of steam an hour, at 75 to 300 lb. steam pressure. This is accomplished by hot gases from an efficient forced draft fuel-oil fire wiping over a patented 575 ft. steel coil.

5

Crane Cab Conditioners

To fill the need for equipment that ventilates, heats and provides dust and fume protection for operators of crane cabs, Dravo Corporation, Pittsburgh, Pa., has developed two new types of crane cab conditioners. One type, Model VHDF, is designed to provide continuous ventilation, heating, dust filtering, and fume protection for crane cabs and small confined spaces in industrial plants. The other unit, Model VHD, performs the same functions except for fume removal. This model is intended for use where noxious fumes are not a problem but where dust filtering, ventilation or heating may be required.

6

Sound-Proof Telephone Booth

Communication between workers and from field office to the job, particularly where large buildings such as skyscrapers are under construction, is necessarily difficult because of noise, but it can be made

HAISS Material Handling BUCKET LOADERS



FOUR MODELS

Load 3 to 8
Yards Per Min.

SELF-PROPELLED SELF-FEEDING

For loading: sand, gravel, stone, topsoil, coal, snow and similar materials. One man operation, wheel or crawler mounted. Furnished with swivel chute or with swivel belt conveyor.

Special new features include: Sealed anti-friction bearings on head and tail shafts, two or four wheel drive, hydraulic raising and lowering, manganese or roller chain.

HAISS CONVEYORS CAR UNLOADERS



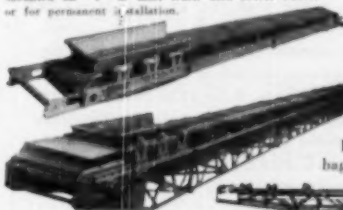
FLAT AND TROUGH BELT CONVEYORS

For handling all types of loose or package materials. Mounted on "V" or motor truck with swivel wheels or for permanent installation.



UNDERCAR UNLOADERS

Designed and built especially for loading sand, gravel, and crushed stone. Combination belt and positive chain drive. Capacity up to 5 tons per minute. Ask for Bulletin No. 561.



SECTIONAL CONVEYORS

Channel or Lattice Frame construction. Made in easily assembled standard sections for permanent or portable installation. All sizes and capacities available for handling all types of aggregates as well as bagged or packaged materials.

For further information, write, 'phone or wire. Experienced Sales Representatives are located in all principal cities.

GEORGE HAISS MFG. CO., INC., Division of **PETTIBONE-MULLIKEN CORP.**
141st to 146th St., on Park Ave., New York 51, N.Y. 4300 W. Division St., Chicago 51, Ill.
Phone Mott Haven 6-2300 Phone Spaulding 2-7000



Additional facts on products described below can be obtained from the manufacturer via postcard inserted at page 74. Each item is numbered. Just circle the corresponding number on the card and mail.

easier by a new type of telephone booth manufactured by the Burgess-Manning Co., Libertyville, Ill. Known as the "Acoustic-Booth," it is doorless and sound proofed and traps high and low frequency noises and permits conversation without raising the voice, even in the noisiest spots.

7

Tractor Shovel

A complete line of newly-designed and improved Shovelloaders, announced by Lull Manufacturing Co., Minneapolis, Minn., have been streamlined throughout and improvements made to assure maxi-



New Shovelloader.

mum operator vision and faster loader operation. The hydraulic supply tank now forms the upper part of the radiator shield which places it directly above the hydraulic pump and greatly improves operating visibility. A removable ventilating section in the center of the radiator shield permits easy servicing of all front-end parts, allows a free flow of air for radiator cooling and prevents the engine from overheating. All of the

new models are equipped with larger capacity Lull precision-built hydraulic pumps with stepped-up gallonage for faster raising, lowering and dumping. Bucket control cylinders have been redesigned and re-located for faster bucket control and better forward vision. The buckets have been improved with a longer lower lip.

8

Snow Removal Attachment

Illustrated herewith in the new 3000 model truck of The White Motor Co., Cleveland, O., with the snow plow developed by Good Roads Machinery Co., Minerva, O. The plow blade and frame are



White Truck with Good Roads Snow Plow easily detachable. Hydraulic jack for raising and lowering the plow is easy to get at and is equipped with single detachable joint. The unit shown is owned by Cleveland Heights, O.

9

Post Hole Digger

A new 5 hp. gasoline-powered post-hole digger, announced by McCulloch Motor Corporation, Los Angeles, Calif., can be converted into a standard McCulloch chain saw in less than a minute, since the engine is the same unit used on this



McCulloch Earth Drill

saw. Conversion consists merely of detaching the drill assembly and attaching a chain saw assembly. Weight of the 2-man earth drill complete with 6 in. auger is 79 lb. It is claimed that a 6 in. posthole 30 in. deep can be dug in less than 15 seconds in any earth. Augers of 9 in. and 12 in. are also currently available.

10

Portable Crushing Plant

A new low-cost portable crushing plant, announced by Pioneer Engineering Works, Minneapolis, Minn., is the single pass type and has a mechanical (reciprocating plant) feeder, 2 ft. x 3 ft. two bearing vibrating screen and may be equipped with a 1016, 1020 or 1024 roller bearing jaw crusher. A gathering conveyor which blends the material from



No. 6 Portable Crushing Plant.

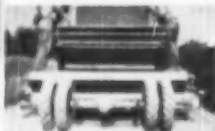
BULLETIN

**EQUIPMENT COSTS CUT 50%
ON SOIL CEMENT PAVING**

BULLETIN

**SPREADER SAVES
SQUARE YARD**

Hercules Cement Spreader outperforms all others—at any price!



A TWO MAN TEAM—plus the Hercules—makes up your complete spreading crew; you save from 2c to 5c per square yard in time, labor, and materials!

You'll complete your soil-cement contracts ahead of schedule... cut labor costs... get even spreading without waste with the amazing Hercules Cement Spreader. Just couple it to any conventional dump truck and you're ready to spread any amounts of cement needed up to ten foot widths—all at a single pass. Ruggedly built, easy to operate, mechanically fool-proof, the Hercules Cement Spreader offers you a real profit opportunity in the soil cement field. Send coupon below for complete information.

Hercules STEEL PRODUCTS CORP., GALION, OHIO

Please send me complete information on _____ NAME _____

☐ the HERCULES CEMENT SPREADER ADDRESS _____

☐ upon territories for qualified distributors CITY _____ STATE _____

the screen and crusher is built into the plant and can be used to load trucks, or to deliver to bin or stock pile. V-belts drive the crusher and screen. Other drives are high speed steel roller chain.

11 Shovel-Crane

A new self-propelled, rubber mounted $\frac{1}{2}$ yd. shovel-crane, announced by Wayne Crane Division, American Steel Dredge Co., Fort Wayne, Ind., has a 10-ton lifting capacity with extended outriggers and auxiliary counterweight. The working weight as a shovel is 30,360 lb. The model is easily convertible to all front-end attachments. A single 62 h.p. engine,



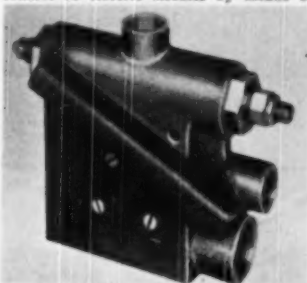
Wayne Crane Model 20 as a Shovel. gasoline or diesel, supplies motive and operating power. The model travels, lifts, booms and swings simultaneously or independently. Four-point "walking" beam suspension provides equal stability while lifting or digging even on rough terrain. Full 360° operation, 7 ft. 8 in. wheelbase and short turning radius facilitate operations in "tight" spots. Mounted on four sets of dual pneumatic tires, the new model travels at speeds up to 15 m.p.h.

12 Construction Tools

Under the trade name of "Structo", Arrow Tools, Inc., 1900 S. Kostner Ave., Chicago 23, Ill., has placed on the market a completely new line of tools for use by building contractors, steel fabricators, bridge builders, road and street contractors, oil industry installations, etc. The new line consists mainly of mallets and chisels for concrete breaking, sledges, hammers, rivet sets, tongs, wrenches, drift pins and air hammer tools.

13 Hydraulic Pressure Electric Switch

A new cartridge-type hydraulic pressure electric switch announced by Pantex Manufacturing Corporation, Pawtucket, R.I., features precision performance plus overload protection. Designed for the precise control of electric circuits by means of



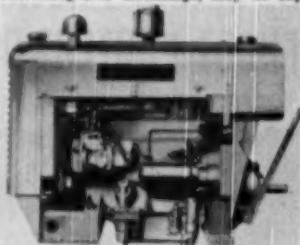
Pantex Electric Switch

hydraulic-pressure actuation, this switch will cut-in and cut-out electric circuits with as little as 12 to 18% pressure differential. Unaffected by extreme pressure surges, temporary or sustained; the unit has also withstood a wide temperature differential ranging from -65°F to 160°F without loss of accuracy or other desirable operational characteristics.

14 Power Units

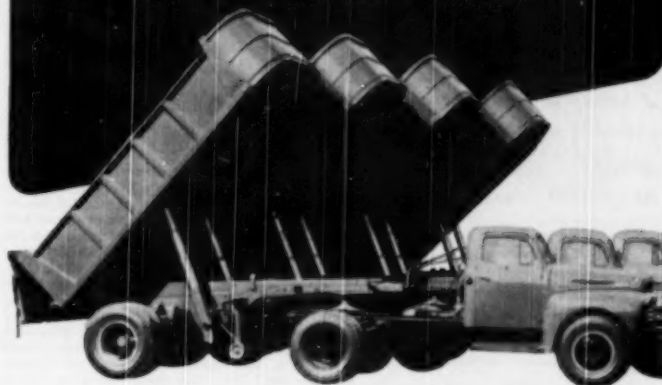
A new line of industrial engines, announced by Waukesha Motor Co., Waukesha, Wis., introduces a series of portable power units built around three basic sizes, a four cylinder and two six cylinder engines. These three basic sizes are made as diesel, gasoline, butane or natural gas engines and carry approximately the same output ratings, size for size, whether diesel or carburated fuels are used. The Model 180-DACU, 4-cylinder diesel has

an output of 22 hp; Model 185--DACU 6-cylinder diesel, 33 hp; Model 190--DLCU 6-cylinder diesel 45 hp., all at 1800 rpm. The three natural gas, butane, and gasoline, power units which are counter parts of the diesel power units, and which have interchangeable mountings, may be sup-



Waukesha Model 180-DACU

Get More Trips per Truck-Day with "On the Job" Design



Boost the daily payload of your trucks by taking advantage of the special features built into Marion Bodies and Hoists. Under actual work conditions, Marion engineers design each unit to fit the particular needs of every hauling job. This assures peak performance and rugged, dependable stamina for your individual truck requirements. Write for complete catalog today.

Model Illustrated: Marion 12 cu. yd. semi-trailer dump bodies for hauling crushed stone and gravel. Mounted over Marion twin telescopic 7" hoist.



MARION

BODIES AND HOISTS

GET MORE DETAILS NOW
Just mail a post card or letter for the complete Marion catalog, or ask your Marion Distributor.

MARION METAL PRODUCTS CO., MARION, OHIO

SISALKRAFT CURING BLANKETS PROVIDE FROST-PROTECTION

EFFECTIVE and ECONOMICAL



Temperatures recorded automatically under actual field conditions prove Sisalkraft provides amazing protection against frost.

- ✓ 17-degree margin of safety in sub-freezing temperature.
- ✓ Effective as a 12-inch layer of straw . . . and easier to apply and remove.
- ✓ Assures more uniformly dependable protection and curing.
- ✓ Truly economical because it can be RE-USED 15 times or more.
- ✓ Saves time, labor and materials.
- ✓ Helps you complete your late paving schedules despite cold weather.
- ✓ Takes guesswork out of frost-protection.



WRITE TODAY
For VALUABLE
26-page Book
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205 W. Wacker Drive, Chicago 6, Ill.
Please send the SISALKRAFT Road Book to:

Name _____
Firm Name _____
Address _____
City & State _____

The SISALKRAFT Co.

Chicago 6 • New York 17 • San Francisco 2

Additional facts on products described below can be obtained from the manufacturer via postcard inserted at page 74. Each item is numbered. Just circle the corresponding number on the card and mail.

plied with either gas, gasoline, or combination gas-gasoline carburetors, and being high compression, overhead valve engines there is no other change than carburetor and timing adjustment needed when switching from gas to gasoline operation. The other models are: The 4-cylinder Model 180-GLU gas or gasoline engine with a rating on either 1000 BTU gas or 70 octane gasoline of 25 hp. The 6-cylinder Model 185-GLU gas or gasoline engine with a rating of 39 hp. and the 6-cylinder Model 190-BTU gas or gasoline engine with a rating of 46 hp.

15

Self-Propelled Scraper

More powerful 225 h.p. engine and larger 24.00 x 25 24-ply low pressure tires have been adopted as standard equipment for the new Model TC-S142 Terra Cobra self-propelled scraper of Wooldridge Manufacturing Co., Sunny-



New Wooldridge Scraper.

vale, Calif. Substantially increased speed, gradeability, traction, flotation, and load-carrying capacity are claimed. A number of other new features have been introduced including formed steel construction for increased ruggedness, 65-in. apron opening and curved ejector designed for faster discharge of sticky materials, increased ground clearance, and a number of other improvements. The new machines are now in full production after successful job testing.

16

Power Take-Off

A Top-Mounted Power Take-Off which eliminates need of a conventional V-belt drive has been announced by Mobile Power, Inc., Box 997, Lansing, Mich. Known as the Tangen, the new unit, which has been tested under actual working conditions for the past five years, is direct-connected to the vehicle engine, operating at full efficiency whether vehicle is in motion or stationary. Speed is governed by crankshaft speed without



Tangen Power Take-Off.

SUMMER

rains have shortened your
asphalt paving season . . .

THIS FALL

catch up on lost working days

with

DARAKOTE

anti-stripping additive

Don't let the end of September mean the end of your asphalt season. Use **DARAKOTE**, and you can continue cold-patch and repair work far into the Fall . . . despite cold, wet Fall weather.

With **DARAKOTE**, you can coat cold, wet aggregates with cut-backs and road oils . . . and your patches stay put. **DARAKOTE** actually displaces water, permanently binds asphalt to the aggregate, prevents stripping even during heavy Fall rains.

DARAKOTE is more effective at all working temperatures. It maintains its strength, can't cook out or deteriorate in processing.

For asphalt cements, cut-back asphalts, road oils, road tars . . . **DARAKOTE** is a more efficient anti-stripping additive.



ANOTHER **DARAKOTE** JOB
Re-surfacing section of U. S. Highway
#1 at Attleboro, Mass.

Dewey and Almy Chemical Company

Cambridge 40, Mass. Chicago 38
San Leandro, Calif. Montreal 32

There Is No Substitute for Quality

You are always sure of the finest quality equipment identification with a genuine FLEXO-SCREEN.



And so easy to apply, too—no experience or skill necessary.

Fits door curves and flat surfaces with equal perfection.



QUANTITY as Well as QUALITY

Hundreds of applications of fine yet durable lettering in raised enamel that defies the elements. Will not crack, chip, peel or fade.

If you are economy-minded, yet like the finest identification, then you will appreciate the merits of the FLEXO-SCREEN.

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**EQUIPMENT
IDENTIFICATION CO.**
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relation to transmission range. It is stated to deliver 98% of engine torque transmitted direct from main drive gear in transmission. Unit is easily installed and becomes an integral part of transmission without affecting driving mechanism. It is manufactured to fit almost every make of truck. If desired at any time, the unit may be removed and the truck again made standard.

17

Hydraulic Scarifier

A hydraulic scarifier for use on the Hough Payloaders has been introduced by Kay-Brunner Steel Products, Inc., Los Angeles, Calif. The package unit consists of a Kay-Brunner scarifier, rams, control valve and all fittings. The unit utilizes the existing hydraulic



Scarifier Unit on Hough Payloader.

system on the Payloader. Ripper bar, which clears Payloader hitch when raised, has five adjustable shanks with H & L removable teeth. Specifications include: Ripping width, center to center of outside teeth, 70 in.; Penetration, 8 in.; Raised height, 21 in.; Teeth spacing, 17½ in.; Teeth shanks, 1½ in. x 3 in. x 18 in. Weight, complete unit, 1,100 lb.

18

Fire Hose Couplings

A new complete line of fire hose couplings and fire hose coupling accessories has been brought out by the Hose Accessories Co., Philadelphia, Pa. This new Le-Hi line of fire hose coupling includes satin finish pin lug and Glider lug coupling in a complete range of sizes and types for chemical, linen, mill and fire department hose. Rounded lugs on Le-Hi Glider lug couplings glide right over curbs, ladder rungs, stairs and other obstructions.

19

Puller for Construction Work

A new hand-operated hoist or puller, announced by the Coffing Hoist Co., Danville, Ill., weighs 9½ lb., takes up less than a foot of space, yet handles a full 1,000-lb. load on any lifting, stretching or pulling job. This combination of easy portability and big pulling power is stated to make it especially useful as an extra hand around construction projects. It fits neatly into a truck or tractor tool box, is easily carried from place to place. With it, one man can do the work of many on such jobs as repairing heavy



Mighty Midget Puller Servicing Grader.



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pumping**



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5-way comparison
with any other pump**

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Latest type 2" and 3": Compact heavy duty units with weather-shielded engines.



4" to 10" Peristaltics: Specially housed for easy access to engines, larger fuel tanks.



Aluminum Pumps: with replaceable liners, stainless steel shell fitting. 1½", 60 lbs., up to 5700 gph.—2", 105 lbs., 9000 gph.



Jetting Pumps: For pressures to 275 lbs. Also 2" to 8" pressure pumps for supply work. Diaphragm pumps for sand and mud.



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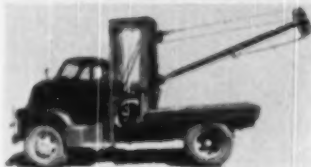
Additional facts on products described below can be obtained from the manufacturer via postcard inserted at page 74. Each item is numbered. Just circle the corresponding number on the card and mail.

machinery in the field. The handle serves a double purpose. It may be used as a straight lever when loads are especially heavy, or where lack of headroom allows only partial strokes; or the lower section may be locked at right angles to the upper section, forming a crank for high-speed lifting or pulling.

20

Hydraulic Truck Crane

A new low-cost mobile truck crane, announced by Pitman Manufacturing Co., Kansas City, Mo., can be easily installed on any type of crane and used with any make winch. It takes up only 35 in. behind the cab. Features of the



Hydra-Lift Truck Crane.

crane include: Smooth, positive hydraulic action, full 180° swing, full 100° lift, boom that can be telescoped from 11 ft. to 16 ft. or 20 ft., hydraulic power system with operating pressure of 1250 p.s.i., that can be run off fan belt or power take-off, capacity varying from 6,000 lb. with short boom to 2,500 lb. with boom at 20 ft.

21

New Engine for FWD Truck

The Four Wheel Drive Auto Co., Clintonville, Wis., has announced adoption of a new 195 GKA valve-in-head engine as standard equipment for the Model HA FWD truck. Adding speed and power to the HA, the new engine has both in-

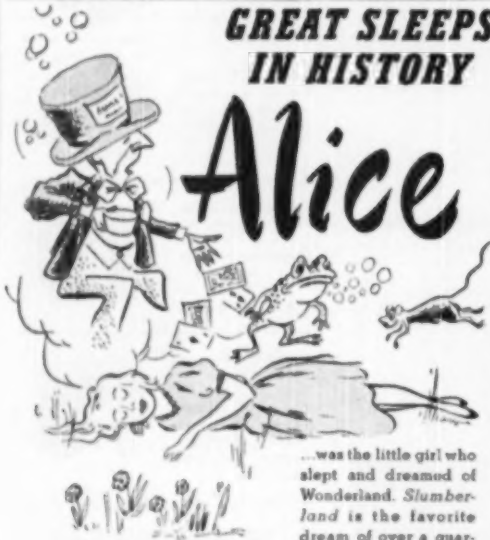
(Continued on page 75)



Model HA Four Wheel Drive Chassis

GREAT SLEEPS IN HISTORY

Alice



...was the little girl who slept and dreamed of Wonderland. *Slumberland* is the favorite dream of over a quarter of a million guests who annually rest on those wonderful, cloud-comfortable beds at

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U. S. Public Roads Adm.

A word or phrase in one branch of engineering may have an entirely different meaning in some

other branch. This book is offered as a step toward avoiding misunderstanding between the different branches of engineering, the public and other professions. It is arranged in dictionary form. Appendices include foreign language terms; symbols; abbreviations; weights and measures; conversion factors. 439 pages—\$4.00 plus postage.

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Compiled from a series of articles written for Roads and Streets magazine by a group of well-known highway engineers, it contains the elementary principles of soil mechanics and soil stabilization. The demand for this book has been world wide. It is a vital need for the engineer considering low cost road improvement or grading embankment control. Profusely illustrated—141 pages—\$2.00 plus postage.

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These young Macks are out to beat their dads!

Their great-grandfathers are still at work—but these new Golden Anniversary Macks have everything that made their ancestors famous.

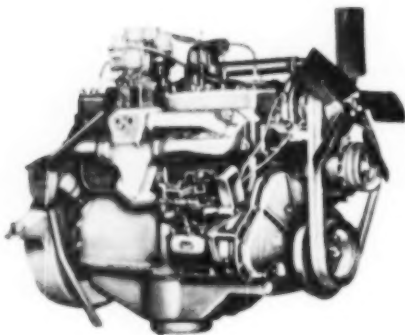
In these new Macks are all the built-in dollar-savers Mack is famed for—the greater stamina, greater strength that come from half a century of specializing in the development and the manufacture of commercial vehicles. All reasons why —“Mack outlasts them all!”

And introduced for the first time is the new *Magnadyne* Engine. Designed by Mack—it is

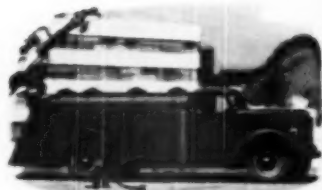
completely Mack-built in Mack's own engine factory. A worthy running mate for a power-plant that is renowned among truckmen the world over—Mack's great *Thermodyne* Engine.

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There's a Mack for your job with a great



Originated by Mack, designed by Mack —completely Mack-built in Mack's new engine factory—the new *Magnadyne* Engine is money-saving news for truckmen. Mack-proved timing gears —gears that have never been known to wear out, the new triple-life manifold, directed jet-water cooling that increases valve life, a fully counter-balanced electrically case-hardened crankshaft—these and many other exclusive features and improvements add thousands of trouble-free miles, extra working miles, *earning* miles for Mack owners.



THE NEW MACK A-30—(21,000 lbs. g.v.w.) is the dollar-saver Mack for oil dealers, lumbermen, farmers, stockmen and all truck operators who need a truck of the medium capacity class with Mack's built-in economy, stick-to-the-job stamina and Mack's ruggedness and long life.

Golden Anniversary Macks



THE NEW MACK A-30—(17,000 lbs. g.v.w.) offers grocers, packers, bottlers, department stores and others a small Mack with Big-Mack dependability.

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Quick Help on Product Information

1. For latest information on any product you need in roadbuilding, earth moving heavy construction, etc., use business-reply card inserted in this publication. Just fill in our code numbers on blank lines of Part "C" of the postcard. Fill in name, address, etc., tear out, and mail.

2. For information on particular products advertised in this issue, use Part "A" of the bound-in cards.
3. Part "B" of the cards is also usable for further information on any items described in the "New Equipment and Materials" or "Manufacturers Literature" sections of the magazine.

A		3002 Cement, Portland	F		4404 Lights, Acetylene
7201 Acetylene Gas	3603 Cement, Quick-Setting	1211 Feeders, Aggregate	4402 Lights, Flood		4405 Lights, Flood (for Equip-ment)
2901 Additives, Bituminous	3604 Cement, White	2006 Felt, Subgrade (Elastic)	4406 Lights, Warning (for Equip-ment)		7608 Liner Plates, Tunnel
6201 Air Cleaners	3205 Centering, Concrete Arch Form	4201 Filing Systems	7609 Linings, Brake and Clutch		2202 Lips, Bucket
1001 Air Compressors	3605 Center Strip Materials, Road	2605 Finegraders (Subgraders)	5402 Loaders, Belt		5401 Loaders, Bucket
1002 Air Comp., Self-Propelled	7401 Chain	1809 Finishers (Pavers), Bituminous	5403 Loaders, Front-End		5404 Loaders, Truck-Mounted
1003 Air Tool Accessories	1205 Chain, Conveyor	2606 Finishers, Vibrating	3605 Lubricants		3606 Lubricants, Compressor and Air Tool
3202 Arches, Corrugated Metal	2811 Chutes, Concrete and Dry Material	2607 Finishing Machines, Concrete	3607 Lubricants, Diesel Engine		3608 Lubricants, Grease and Oil (Engine)
2005 Asphalt, Emulsion	6405 Clearing Equipment, Tractor-Mounted	7403 Fittings, Wire Rope	3609 Lubricants, Wire Rope		
2004 Asphalt, Liquid	3601 Cleaning Solvents	4401 Flares (Torches)			
2005 Asphalt, Powdered	2602 Cleaners, Cement Bag	4005 Fluid, Hydraulic			
7002 Axles, Truck	5201 Compactors, Soil	5802 Flushers, Street			
B		2007 Flux, Bituminous			
6801 Backfillers	2603 Concrete Placers	2815 Forms, Catch Basin and Manhole (Concrete)			
1004 Backfill Tampers	3206 Connectors, Timber	2815 Forms, Concrete Construction			
3014 Bars, Concrete Reinforcing (Accessories)	5405 Control Equip., Cable	2817 Forms, Curb, Road and Sidewalk (Concrete)			
1401 Batches, Aggregate	4004 Control Equipment, Hydraulic	3603 Fuel, Diesel and Gasoline			
3602 Batches, Cement	4812 Control Equipment, Tag-line				
2801 Batches, Water	1205 Conveyors, Belt				
6202 Batteries, Elec. Storage	4802 Cranes, Crawler-Mounted				
4601 Beads, Glass Reflecting	4803 Cranes, Hydraulic				
7601 Bearings, Roller	6407 Cranes, Tractor-Mounted				
6001 Belting, Conveyor	4804 Cranes, Trailing, 2-Wheel				
2804 Belts, Concrete-Finishing	4805 Cranes, Truck-Mounted				
2805 Benders, Bar	4806 Cranes, Wheel-Mounted				
2806 Bins and Hoppers	6408 Crawler Tracks				
1007 Bits, Drill: Sharpeners	3219 Cribbing, Retaining Wall				
1005 Bits, Rock Drill	1207 Crushers, Jaw				
1602 Bitum. Hot Patch Units	1202 Crushers, Roll				
2201 Blades, Grader, Loader and Scraper	3207 Culvert Cleaning Tools				
3601 Blades, Toothed (Ice Removal)	3208 Culverts, Corrug. Metal				
6601 Block and Tackle	3209 Culverts, Sectional Plate				
3601 Block Machines, Concrete	2604 Curing Machines, Concrete (Spray)				
3203 Boat Spikes & Drift Pins	3007 Curing Materials, Concrete				
7001 Bodies, Agitating	2813 Cutters, Bar and Rod				
7003 Bodies, Dump	4001 Cylinders, Hydraulic				
7004 Bodies, Flashed					
7005 Bodies, Garbage Col.					
7006 Bodies, Pick-up					
7602 Booms, Special					
1203 Breakers, Impact					
1006 Breakers, Pavement					
2807 Bridges, Float					
3204 Bridges, Suspension					
1806 Brooms, Drag					
1807 Brooms, Road					
2401 Buckets, Cableway					
2402 Buckets, Clamshell					
2403 Buckets, Clamshell (Hydraulic)					
2404 Buckets, Concrete					
2405 Buckets, Dragline					
2406 Buckets, Dredge					
2808 Buggies and Carts, Conc.					
7604 Buildings, Demountable					
6405 Bulldozers					
6401 Bulldozers, Angling					
6404 Bulldozers for Motor Graders					
C					
7605 Cars, Industrial Railway					
5801 Carts, Street-Cleaning					
1204 Car Unloaders					
2407 Castings and Parts, Mang- anese Steel					
3001 Cement, Air-Entraining Portland					
2802 Cement, Asphaltic					
D					
3210 Decking, Bridge (Open and Solid)					
7606 Derricks					
2408 Dippers, Shovel					
1802 Distributors, Bituminous					
3008 Dowels and Assemblies					
4807 Draglines, Walking					
1215 Drags, Sand					
5002 Dredges					
1201 Driers, Aggregate					
3401 Drills, Cable Tool (Well)					
3402 Drills, Core					
3403 Drills, Earth-Boring					
3404 Drills, Electric Hammer					
1009 Drills, Rock (Hand-Held)					
1010 Drills, Rock (Tripod)					
1011 Drills, Rock (Wagon)					
E					
1210 Elevators, Bucket					
2814 Elevators, Cement (Bulk)					
4602 Enamels, Equip. and Sign					
6203 Engines, Diesel					
6204 Engines, Distillate					
6205 Engines, Gasoline					
6602 Excavators, Slackline Ca- bleway					
F					
4403 Lanterns					
5803 Leaf-Collecting Machines					
G					
3212 Gates, Drainage					
1214 Generator Sets, Engine					
1810 Generators, Steam					
3801 Graders, Elevating					
3803 Graders, Motor					
3802 Graders, Pull-Type					
3604 Graphite					
2409 Grapples					
2405 Grinders, Concrete-Surf.					
1212 Grizzlies					
3213 Guard Rails					
H					
7202 Hard-Facing Rods					
1813 Heaters, Pavement-Surface					
1814 Heaters, Tank Car (Bituminous)					
1815 Heaters, Tool (Bitum.)					
1816 Heaters, Torch					
2819 Heaters, Water					
7607 Hoists, Electric					
4003 Hoists, Hand					
4002 Hoists, Hydraulic (Body)					
1012 Hoists, Pneumatic					
4808 Hoists, Power Drum					
6002 Hose, Air					
6003 Hose, Cement-Handling					
6004 Hose Couplings					
6005 Hose, Metal (Flexible)					
6006 Hose, Suction					
6007 Hose, Water					
I					
4006 Jacks, Hydraulic					
2608 Joint-Cleaning Machines					
2609 Joint-Installing Machines					
3010 Joint Plates, Base (Waterproof)					
3011 Joint-Sealing Compounds					
3012 Joints, Pavement					
J					
4403 Lanterns					
5803 Leaf-Collecting Machines					
K					
1803 Kettles, Bituminous					
L					
4403 Lanterns					
5803 Leaf-Collecting Machines					
M					
4809 Magnets, Lifting					
3805 Maintainers, Pull-Type					
3804 Maintainers, Under-Tractor					
3806 Maintainers, Under-Truck					
7610 Melting Pots, Lead					
1811 Mills, Grinding (Asphalt)					
1817 Mixers, Bituminous					
2610 Mixers, Concrete					
2611 Mixers, Mortar and Plaster					
3807 Mowers, Highway					
2612 Mud Jacks					
N					
O					
1013 Oilers, Air-Line Air-Tool					
P					
5003 Packing, Pump and Valve					
4605 Paints, Priming					
4603 Paints, Rust-Preventive					
4604 Paint Sprayers and Compressors					
4608 Paints, Traffic line					
4606 Paints, Traffic Line Marking (Reflecting)					
2613 Pavers, Concrete					
3214 Pile Drivers					
3216 Piling, Bridge and Found.					
3215 Piling, Steel-Sheet					
3211 Pipe, Drainage (Perf.)					
5001 Pipe, Dredge					
3217 Pipe-Joint Materials					
2008 Planking, Asphalt					
1818 Plants, Asphalt (Emulsified)					
2802 Plants, Batching (Cone.)					
2803 Plants, Batching (Low-Bin, Trolley-Type)					
1604 Plants Bituminous (Portable)					
1601 Plants, Bituminous (Stationary)					
1603 Plants, Bitum. Travel					
2809 Plants, Cement (Bulk: Portable)					
2812 Plants, Concrete-Mixing (Portable)					
/ List continued on opposite page /					

(List continued on opposite page)

Quick Help on Product Information

2810 Plants, Concrete-Mixing (Stationary)	3281 Reds, Bridge Anchor	5806 Snow Plows, Rotary (for Motor Graders)	4699 Traffic Line Marking Machines
1208 Plants, Crushing and Screening (Portable)	5206 Rollers, Drawn	5607 Snow Plows, Sidewalk	6603 Trailers, Flatbed
1209 Plants, Crushing and Screening (Stationary)	1801 Rollers, Grid-Type	3608 Snow Plow Wings	6604 Trailers, Tilting
5004 Power Plants, Portable	5202 Rollers, Pneumatic-Tired	4202 Soil Sampling and Testing Sets	6605 Tramways, Aerial
7098 Power Take-Offs, Truck	5203 Rollers, Tandem	5208 Soil Stabilizers	6602 Trenching Machines
6296 Power Units	5205 Rollers, 3-Wheel	1805 Sprayers, Bituminous	2616 Truck Mixers
3218 Preservatives, Wood	5207 Rollers, Trench	2615 Spreaders, Concrete	7011 Trucks, Highway
3406 Presses, Crawler Track Pin	5910 Rubber Road Materials	1404 Spreaders, Dry Material	7007 Trucks, Industrial (Fork)
4801 Pull Shovels (Backhoes)	6207 Rust Preventives, Engine	2412 Steel, Alloy	7012 Trucks, Off-the-Highway
6403 Pull Shovels, Tractor-Mounted		3015 Steel, Concrete-Reinforce	7614 Tubing, Steel (Seamless)
6402 Pull Shovels, Trailing, 2-Wheel	S	1008 Steel, Drill	U
1213 Pulverizers, Hammer	2820 Salamanders	7404 Steel, Structural	
5005 Pumps, Bituminous	1804 Sandals, Blum, Paving	4203 Surveying Instruments	3220 Underpasses, Pedestrian and Livestock
5014 Pumps, Centrifugal (Portable)	4607 Sand Blasters	5804 Sweepers, Street	V
5006 Pumps, Centrifugal (Stationary)	3408 Saw Rigs		
5007 Pumps, Diaphragm	3407 Saws, Chain	T	
5008 Pumps, Displacement	1402 Scales, Weigh-Batcher	7010 Tall Gates, Elevating	4007 Valves, Hydraulic
5009 Pumps, Dredge	1403 Scales, Wheelbarrow	1819 Tanks, Relay and Storage (Bituminous)	1015 Valves, Safety (Air-Line)
5010 Pumps, Gear	2204 Scarifiers	7612 Tarpaulins	2617 Vibrators, Concrete
5011 Pumps, Grease and Oil	5407 Scrapers, Drawn	2009 Tar, Road	W
5012 Pumps, Hydraulic	5406 Scrapers, Self-Propelled	2205 Teeth, Bucket, Ripper, Scarifier, etc.	
5013 Pumps, Jetting	2821 Screeds, Concrete	3016 Tie Rods	5408 Wagons, Dump
5015 Pumps, Rotary	2614 Screeds, Vibrating	6009 Tires, Construction Equipment	1217 Washers and Scrubbers, Aggregate
	1216 Screens, Vibrating	6010 Tires, Truck	4610 Waterproofing Compounds
R	3809 Scythes, Power	3409 Tool Carts	7203 Welding Apparatus
3808 Rake Attachments for Graders	2410 Sheaves	1812 Tools, Hand (Bituminous)	7204 Welding Rods
6008 Reels, Hose	4810 Shovels, Crawler-Mounted	2818 Tools, Hand (Concrete)	3411 Wheelbarrows, Power
2203 Rippers and Rooters	6409 Shovels, Tractor-Mounted	3410 Tools, Mechanics' (Construction and Equip.)	2413 Wheels, Steel
1014 Riveters and Chippers, Pneumatic	7009 Shovels, Truck-Mounted	2822 Towers, Material-Hoisting	3810 Wideners, Highway
	7611 Signs, Road	7613 Track, Industrial-Railway	4908 Winches
	5602 Snow Fencing	6208 Tractors, Crawler	3017 Wire, Form and Tie
	5603 Snow Loaders	6209 Tractors, Wheel	3009 Wire Mesh, Pavement
	5604 Snow Plows, Blade and V-Type		7405 Wire Rope
	5605 Snow Plows, Rotary		

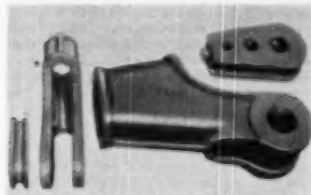
(Continued from page 70)

creased horsepower and increased torque. Rated at 125 maximum brake horsepower as compared to 105 in the previous standard engine, the 195 GKA has a torque of 245 lbs. ft. as compared to 237 in the previous standard. The added power and torque will provide greater speed, greater hauling ability and will permit peak truck performance at fewer revolutions per minute, reducing engine wear, FWD officials stated.

22

Dragline Sockets Save Rope

Wire rope sockets claimed to reduce dragline rope breakage are now being produced by Baer Steel Products, Inc., Auburn, Wash. The Baer socket and its wedge grip rope in true-circle seats. Wide shoulders limit pinching—prevent rope distortion and cutting, and prevent seats from wearing out of round. The rope cannot flatten or crush—rarely breaks at the



Baer Wire Rope Socket

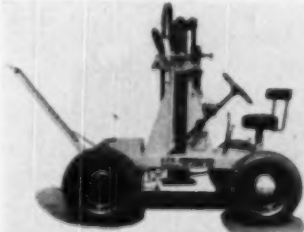
socket. Socket and wedge seats are matched to the size rope for which they are specified. Each socket holds a loop of

six complete strands. Gripping pressures are limited by the shoulders so that rope may flex normally at the socket without breaking and so that pulling and bending stresses are absorbed evenly over the entire wedge and socket seating area.

23

Pavement Breaker

A new model pavement breaker, added to the line of R.P.B. Corporation, Los Angeles, Calif., is automatically controlled, which practically eliminates all of the upsurge of the piston against the top head and 95% of the over-reach on the bottom head. This machine was designed after two years' experience with the one-wheel drive Mighty Midget pavement



Model B Pavement Breaker

breaker and has several improvements over the original machine. It is equipped with a 200-lb. head which gives a more effective blow, especially in the cutting of asphalt. It is equipped with a conventional automobile rear end, driving on both wheels, which makes it a

very simple matter to keep this machine on the line while in action. It is equipped with an automatic attachment with the auxiliary cylinder standing parallel with the main cylinder.

24

Axle Bearing Nut Wrenches

New heavy duty adjustable axle bearing nut wrenches, brought out by Owatonna Tool Co., 435 No. Cedar St., Owatonna, Minn., will remove lock nuts and adjust bearing nuts on full floating truck axles as well as truck front and trailer axles. Cleverly designed, the wheel itself actually is made to do the work—an adjustable cross bolt engages the wheel studs—so a turn of the wheel tightens or loosens the



OTC Axle Bearing Nut Wrench

Additional facts on products described herein can be obtained from the manufacturer via postcard inserted at page 24. Each item is numbered. Just circle the corresponding number on the card and mail.

nut. A pilot insert in the axle prevents cocking. The snug fit, the adjustable feature and the practical design prevent wear on tools and equipment so each wrench should last for years. Four of the wrenches adjust to fit Hex sizes from 2 in. to 4 1/4 in. and three fit Octagon sizes from 3 in. to 5 in.

25

Segmented Guide Roll

A new type of segmented guide roll for its tandems in the 8 to 15 ton class, announced by the Buffalo-Springfield Roller Co., Springfield, O., is said to give



Buffalo-Springfield Segmented Guide Roll better compactive results than obtainable with a sheepfoot type roller. The roll can be installed on both the old and

**FULLY AUTOMATIC...
SELF-PROPELLED...
FASTER MARKING...**



"Super 10" HIGHWAY MARKER FOR PAINTING SAFETY-APPROVED CENTER LINES

The last word in traffic markers! Lays down clean-cut single, double, or triple center lines — solid or intermittent — in one or two colors, at 6 to 10 miles per hour. No special skill or previous experience needed. Retrace old lines — apply reflectorizing paint. Center-pivoted steering for marking symmetrical curves and straight lines. Long forward vision with telescopic caster-wheel guide. Self-propelled—carries two 30 gal. paint tanks. Send today for illustrated Bulletin 152.

new M-B 501 POWER GRADER

FIRST IN THE FIELD WITH EXTRA-LARGE TIRES...
FOR BETTER FLOTATION, TRACTION, PERFORMANCE

This all-around useful new M-B Model 501 Power Grader handles any job such as 1 to 1 sloping, road-building, maintenance, ditching, scarifying, loading, snow removal. Hydraulic blade shift and moldboard circle. Big 50 H.P. Gas or Diesel Engine mounted over axle. Many useful attachments available. Ask for Bulletin 154.



MEILI-BLUMBERG CORPORATION

BOX 245, NEW HOLSTEIN, WISCONSIN, U. S. A.



ROAD EQUIPMENT

new Buffalo-Springfield Models. The new segmented roll consists of two sections mounted on roller bearings and free to rotate independently on the guide roll axle. Heavy steel pads, mounted on sturdy spokes, are placed in staggered rows around the axle, forming the actual compacting surfaces of the roll.

MANUFACTURERS' LITERATURE

26

File Simplification

"How To Simplify Your Files and Filing Systems" is the subject of a new 40-page booklet released by Remington Rand Inc., New York, N.Y. This booklet is based on the premise that many time saving, work saving filing techniques are often unknown to the average file clerk.

27

Jacking Equipment

Methods of jacking concrete pipe, corrugated pipe or well casing are described in a new catalog issued by Rodgers Hydraulic, Inc., Minneapolis, Minn. The equipment used for this purpose also is described. Descriptions and illustrations are given of Rodgers line of jacks which include units in capacities of 50 to 600 tons operated by hand or power pumps for general use throughout the construction industry.

28

Troughing and Return Idlers

New information on troughing idlers and return idlers of improved design claimed to eliminate "high-speed rattle" and reduce maintenance costs is available in two new folders just issued by The Conveyor Co., of Los Angeles, Calif. Covered in the pamphlets are features of the new "snug" design and its application to permanently lubricated ball-bearing type idlers and roller bearing idlers. Each type troughing idler is designed for specific fields of use. Applications of these improved idlers varies from sanitary food handling to rugged operations in mines, smelters, pits and quarries, etc.

29

Power Shovels and Cranes

A new 18-page catalog on the Lorain-TL Series of power shovels and cranes has been announced by The Thew Shovel Co., Lorain, O. This series of machines in the 1/2 and 3/4 yd. classes may be mounted on a wide variety of crawler and rubber tire mountings according to varying ground and travel needs, and includes self-propelled and moto-crane models. The many combinations available to choose from are explained in detail in this new catalog. The interchangeable "units" or "packaged" assembly pioneered by the Lorain-TL Series is graphically illustrated in a series of "phantom" and "built-up" views.

30

Spray Bars

Fraco full circulating hot spray bars for distributors are illustrated and described in a circular issued by The Fraco Manufacturing Co., Richmond, O. These bars are available as original equipment on leading distributors and can be easily attached as replacement bar on any

A 1000-1/2 LC

make of distributor. A feature of these bars is that the Fraco nozzle always gives an exact spray, constantly the same. The bars give any spread from 1 ft. to 24 ft. or more. The valves are turned on and off by a single control bar. Since they are fastened in units of 3 or 4 in. centers, any part of the bar can be controlled separately.

31 Track-Type Tractor

A 32-page illustrated booklet, published by Caterpillar Tractor Co., Peoria, Ill., describes practically every part of the "Caterpillar" Diesel D7 tractor with complete specifications. The engine, fuel system, and lubrication system are just a few features of the D7 Tractor which are thoroughly discussed and illustrated.

32 Dual Portable Crushing Plant

A new catalog on dual portable plants for crushing, screening, and loading has been issued by Smith Engineering Works, Milwaukee, Wis. Illustrations show many dual portable plants on the job; and of special interest is a spread showing in color typical Tel-smith dual plant combinations—which vary from the dual portable with plant-mounted feed hopper and truck loading conveyor to the dual portable combined with a complete washing and screening plant.

33 Industrial Maintenance Tools

A 20-page bulletin published by the Owatonna Tool Co., 435 North Cedar St., Owatonna, Minn., illustrates and describes new tools skillfully designed to accomplish difficult removing and replacing operations efficiently without ruining costly, irreplaceable parts. The OTC pulling system which consists of the OTC Grip-O-Matic pullers and OTC Push-Pullers, with various adaptors and attachments is featured, and the illustrations show typical puller jobs made easy with these time and labor saving tools.

34 Centrifugal Pumps

New catalog bulletins announced by Rice Pump & Machine Co., Milwaukee, Wis., cover the Rice 3 in.—15M self-priming centrifugal pump, as well as the 7M and 10M sizes. Rice Pumps feature such improvements as bellow type shaft seals entirely enclosed within a cartridge; hardened steel wearing plates, built-in check valve, large clean-out opens, trash type impellers, and direct line flow of water through the suction opening to the impeller.

35 Cranes

The Jones Model KL-15 one-ton wagon crane is described with complete specifications in Catalog No. 159 published by Tractor & Equipment Co., Oak Lawn, Ill., United States distributors of the British made line of Jones wagon cranes and locomotive cranes. Literature on the larger models, KL-22, a 2½-ton crane and KL-44, a 5-ton, will be available in the near future.

36 Street Lighting Equipment

A 16-page catalog published by Elveco Corporation, Cincinnati, O., features its new and standard line of street lighting equipment and accessories. In addition to detailed specifications covering the complete line, the brochure illus-

THE RIGHT
COMBINATION
OF SPEED
AND BRAWN



One hoist may have speed, another brawn. Galion Fulcrumatic hoists have both . . . in the most efficient combination possible—automatically changing lift fulcrums plus extra rugged hoist construction! Result? Swift, effortless unloading . . . extra capacity . . . longer hoist service life . . . ideal distribution of load weight over the entire cba.

Find out what this profitable combination can mean on your particular jobs. See your truck dealer or Galion distributor . . . NOW! The GALION ALLSTEEL BODY CO. • Galion, Ohio.

GEARED FOR THE LOAD

GALION
Allsteel
Fulcrumatic HYDRAULIC JACKS
AND CUMPS BODIES

The ROGERS 4-FEATURE POWER-LIFT DEMOUNTABLE GOOSENECK



STOOPS TO
CLEAR LOW
OVERHEAD
OBSTRUCTIONS



RAISES ITS
DECK TO
CLEAR HIGH
BANKED
CROSSINGS



Patents Pending

**EMBODYING A
NEW AND VAL-
UABLE FEATURE
IN TRAILER
SERVICE**

It embodies the kind of versatility that makes every haul easier, faster, more profitable.

Loading, at a lower angle, is faster. Larger tires carry heavier loads legally. Unloading, reloading, detouring are avoided through quick adjustment of the deck height to different conditions encountered.

It's equally as rugged as the standard Rogers Gooseneck regardless of its detachable feature. And it's available on most Rogers Trailers and adaptable to many trailers of other makes.

Bring your equipment up-to-date and be in a position to handle operations more efficiently and more profitably.

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ROGERS TRAILERS

EXPERIENCE builds 'em

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ROGERS BROTHERS CORPORATION, 110 Orchard St., ALBION, PA.



REPLACE 29 SIZES WITH THESE TWO

**NEW GIANT ALLOY
adjustable wrenches**
THINNER-LIGHTER-STRONGER



Until now 29 wrenches have been needed to handle the jobs done by these two new alloy adjustable wrenches. They are THIN—to get at the work easily. Strong—designed for added strength at leverage points. Light—to make job servicing easy. Economical—saves time, tools and materials. Large jobs become simple ones.

Giant alloy wrench No. OA-24 is 24" long, 1 1/2" thick, weighs only 10 lbs. and adjusts to 13 standard sizes from 1 1/2" to 2 1/2". OA-16 is 16" long, 1 1/2" thick, weighs only 22 lbs. and adjusts to 16 standard sizes from 2 1/2" to 4 1/2".

ANOTHER EXAMPLE OF ENGINEERING THAT MAKES OTC TOOLS OUTSTANDING

OWATONNA TOOL CO.

435 CEDAR ST., OWATONNA, MINNESOTA

REPLACE
29
SIZES
PATENT
APPLIED
FOR



Additional facts on products described below can be obtained from the manufacturer via postcard inserted at page 74. Each item is numbered. Just circle the corresponding number on the card and mail.

trites the gradual transition of lighting standards from 1895 to the present day. The publication is detailed with drawings and cross-section illustrations of the firm's many designs in standards to fit both the specifications of today's lighting engineers and the budgets of cost-conscious municipalities.

37

Concrete Buckets

"Placing Concrete on Big Jobs" is the theme of a new catalog offered by Gar-Bro Manufacturing Co., Los Angeles, Calif. Twenty different models ranging in capacity from 1/3 to 8 cu. yd. are described in the new publication listing complete dimensions, specifications and data on the Gar-Bro line of concrete buckets. A two-compartment Gar-Bro bucket with individually air-operated gates having a total capacity of 8 cu. yd. is shown in action.

38

Snow Removal

A new 16-page booklet, "Beat Back the Snow With 'Caterpillar' Equipment" has been issued by Caterpillar Tractor Co., Peoria, Ill. For the past two years Caterpillar Tractor Co. has sent photographers into those areas where snowfall has been heavy and at times disastrous. Under actual working conditions their photographic scenes show how maintenance crews and snow removal equipment keep the highways and streets open to traffic during the winter months. The new booklet tells its illustrated story of how snow, threatening many regions for almost one-half the year, challenges commerce, industry and life itself.

39

Paint Savings Calculator

Taking the guess-work and arithmetic out of calculating annual savings on various painting cycles, the Paint Sales Division of the Joseph Dixon Crucible Co., Jersey City 3, N.J. has developed a chart which gives, at a glance, the savings in terms of per cent, of different protective painting cycles. The use of this "Painting Economies" calculator enables a maintenance executive to figure the annual per cent of saving that would result by lengthening his painting cycle from 1 to 10 years. Any present cycle, from 2 to 10 years, can be used.

40

Zoning Earth Moving Equipment

The profit advantage of properly zoning heavy earthmoving equipment for efficient production is illustrated and described in a new booklet published by Caterpillar Tractor Co., Peoria, Ill. The booklet presents 16 pages of profitable experience by contractors, engineers, governmental bodies, and other owners in the proper application of machines for high-speed hauling, middle-speed hauling, and power operations. An abundance of photographs illustrate representative uses for rubber-tired units, track-type tractor and scraper combinations, and bulldozer, ripper, and Hystaway operations. Power units suitable for pumping, crushing, and for compressors, lights, and draglines also are pictured at work in the fixed power zone to complete the power picture.

41 Welding Connectors

A new line of welding connectors is pictured and described in a folder issued by Mines Equipment Division, Joy Manufacturing Co., St. Louis, Mo. These plugs engage easily, yet cannot be accidentally disengaged. Molded as a unit of Neoprene and vulcanized to cable they are shatter-proof, jerk-resistant and water-tight. The new circular describes results observed when 500 lb. was suspended by a pair of these new connectors for 24 hours. The circular also describes String-a-lite Portable Lighting lines for industrial use.

42 Gradall Earthmover

A new illustrated catalog, No. 4903, has been published by The Warner & Swasey Company, Cleveland, O., covering the recently introduced new model Gradall earthmover. The new bulletin describes the new machine's operation, lists specifications, and illustrates the Gradall at work on a variety of jobs.

43 Filing Cabinets

A new line of low-priced "Revere" file cabinets is described in a booklet issued by Remington Rand Inc., 315 Fourth Ave., New York, N. Y. The new files, according to the brochure, contain many of the same advantages of durability and fine craftsmanship found in the premium-grade "Aristocrat" cabinets, yet are designed especially for those filing operations in which economy is a major factor. Available in three-, four-, or five-drawer cabinets, and with either letter or legal sized drawers, the files are extremely flexible in that substitute drawers may be employed to accommodate variously sized cards, documents or miscellaneous material in box drawers.

44 Service Tools for MM Tractors

An 8-page bulletin issued by Owatonna Tool Co., 435 North Cedar St., Owatonna, Minn., illustrates and describes a set of tools engineered and developed in cooperation with the Minneapolis-Moline Co. service department for use on MM Tractors and farm implements. Illustrations show typical uses of tools on difficult removing and installation jobs... easily and quickly without damage to expensive parts. This set is made up of basic universal tools which are adaptable to a great many service operations on all makes and models which makes it possible to service and overhaul other tractors.

45 Graders

A 20 page two-color catalog presenting Allis-Chalmers' new 34.7 HP Model D grader has been released by the Tractor Division, Allis-Chalmers, Milwaukee, Wis. Various features of the grader are illustrated and described. A panel of 15 action pictures shows the grader on an assortment of construction and maintenance jobs, such as bank sloping, ditch guiling, shoulder work, scarifying and road maintenance. Several rear-end loader operations also are illustrated. Special attachments such as the tractomotive rear-end loader, one-pass windrow eliminator, Baker V-type snow plow and Allis-Chalmers' scarifier are discussed. A full page of specifications is included.



**METAL POWDER... FINER THAN TALCUM
BRAKES THE GIANT LeTOURNEAU SUPER C**

All-metal Velvetouch friction discs, made from powdered metal compressed and fused with a solid steel backing, stop the powerful Super C... not once but thousands of times... to deliver the extra hours of dependable, trouble-free braking service that cuts operating costs. That's why leading earthmoving equipment manufacturers, like LeTourneau, use all-metal Velvetouch clutch facings and brake linings as standard. They know that Velvetouch lasts longer... BECAUSE IT'S ALL-METAL. And for the same reason, you should insist upon genuine Velvetouch replacement parts. They cost less in the long run!

THE S. K. WELLMAN CO. • 1374 E. 51st STREET • CLEVELAND 3, OHIO



Velvetouch

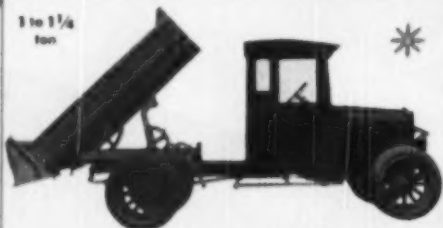
**THE S. K. WELLMAN CO.
WAREHOUSING CENTERS**

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CLEVELAND 1392 E. 51st St.
DALLAS 3407 Main St.
LOS ANGELES 1110 S. Hope St.
PHILADELPHIA 97 E. Montrose St.
PORTLAND 636 N. W. 16th Ave.
SAN FRANCISCO 424 Bryant St.
TORONTO, ONTARIO, CANADA
The S. K. Wellman Co. of
Canada, Ltd. 2838 Balfour St.
WASHINGTON, D. C., OFFICE
1101 Vermont Ave., N. W.

PERFECTION (THE NAME TO REMEMBER) BODIES & HOISTS

TOPS IN 1918

1 to 1 1/4
ton



32 YEARS OF KNOWING HOW

TOPS IN 1950

8 to 12
ton



PERFECTION Hoists and Dump Bodies, with their rugged powerful design, have always made fitting partners for all makes of trucks on the toughest hauling jobs. Truck users know, through years of dependable service, that they have bought the BEST when they have bought PERFECTION. They know that this combination will give them top performance.

In the PERFECTION Line of Bodies and Hoists, you will find a complete range of standard types and sizes which will fill practically every need. When a special body is required, PERFECTION'S long and extensive experience assures you complete satisfaction. Write for complete information today.

THE PERFECTION STEEL BODY CO.
Galion, Ohio

PERFECTION
STAKE and DUMP BODIES
HYDRAULIC HOISTS

FOR ANY TRUCK
STANDARD or SPECIAL UNITS
IN ALL SIZES - FOR ANY USE

Additional facts on products described below can be obtained from the manufacturer via postcard inserted at page 74. Each item is numbered. Just circle the corresponding number on the card and mail.

46

Ground Stabilization Method

The sand-drain method of stabilizing soft marshy ground is described in a folder issued by McKiernan-Terry Corporation, New York, N. Y. The folder explains how this procedure was originated and refers to many of its successful applications throughout the United States. The method of draining water from the soil to be treated is fully described together with an explanation of the equipment used. Among the illustrations are diagrams showing the action of the sand-drain method and many photographs of sand-drain rigs in operation, including the McKiernan-Terry pile hammers, compression loads and specially designed skips which are used on sand-drain projects.

47

Concrete Mixers

Current models of Worthington-Ransome "Blue Brute" big concrete mixers are described in a new bulletin B-1700-B2, announced by Worthington Pump and Machinery Corporation, Harrison, N. J. Redesigned to keep the overall dimensions within minimum limitations, these mixers are for use in central mixing plants, on large construction jobs and public works projects. Three sizes are offered—28-S (1-yd. portable or stationary), 66-S (2-yd. stationary), 84-S (3-yd. stationary), and 126-S (4 1/2-yd. stationary) models. The booklet illustrates how the mixers, when installed in a central mixing plant, can be used in conjunction with truck mixers or agitators. Attachments and accessories, such as the hydraulic control system, are illustrated. Complete specifications and dimensions of the mixers are given.

48

Trenching Machine

Recent improvements in the Model 221 Trenchliner are described in a new catalog announced by the Parsons Co., Newton, Ia., a subsidiary of Koehring Co., Milwaukee. The 12-page catalog shows in detail some of the exclusive Trenchliner features that provide greater production speeds and more versatile operation. Some of the exclusive features explained in the new catalog are: arch type frame for maximum strength, travel clearance and digging balance; offset boom that shifts by power for trenching within 1 1/2 in. of crawler tread clearance on either side; arc type discharge conveyor that shifts through entire machine in less than 1 minute for positive controlled discharge.

49

Bitumuls Paving Handbook

A new 84-page edition of the Bitumuls Paving Handbook announced by American Bitumuls Co., San Francisco, Calif., covers all aspects of paving techniques with Bitumuls emulsified asphalt and also with other types of bituminous binders. Also included are data on Laykold compounded asphalts for tennis courts, flooring, protective coatings, adhesives and waterproofing. Major divisions of this handbook cover the following: Information on paving methods and materials, Specifications on road and airport paving, Complete tabular data on rates of application of asphaltic binders and quantities of aggregate required for various types of construction, Condensed Asphalt Institute specification on asphalt cement and cutback, Listing of an engineering library of free booklets covering individual types of construction.

50

Engineering Instruments

The complete line of Gurley surveying and engineering instruments—transits, engineers levels, alidades, and other instruments—are described in the newly revised edition of Catalog No. 50, just published by W. & L. E. Gurley, Troy, N. Y. The various transits discussed in the 66-page catalog include: The Hell Gate Precise transit—both engineer and the mountain and mining models; the standard precise transit—engineer and reconnaissance models; mining transits; the telescopic solar transit and the contractors and engineers transit. Illustrated too, are Gurley wye, dumpy and precision tilting levels. Other Gurley products described are: standard explorers alidades, plane table outfits, tripods, drawing boards and drawing paper, geodetic rods, wind instruments, hydraulic measuring instruments, current meters, wading rod sets, rain and snow and hook gages, plummets and hand levels.

Photo shows PERFECTION Type 334 Trolley Body (16 ft. long) and No. 1077 (a-Dragline ROLL-A-LIFT). This "Inside-Board" body gives greatest possible capacity in relation to overall size of platform.

FREE
"Old Timer" Photo
Write for an enlarged mounted photo of the old truck pictured in this ad. No obligation.

WITH THE MANUFACTURERS & DISTRIBUTORS

Toro Purchases Coldwell. Toro Manufacturing Co., Minneapolis, Minn., has purchased the Coldwell-Philadelphia lawn mower business. The present Coldwell-Philadelphia dealer organization will carry on as part of Toro's nation-wide sales operation.

New Keystone Sales Representative. Hiram McCullough has been appointed sales representative of Keystone Asphalt Products Co., Chicago, Ill., to cover the Middle Atlantic and New England states. Mr. McCullough was previously associated with National Gypsum Company and U. S. Gypsum Company, and most recently, and until he received an honorable discharge in March of this year, was a Major in the U. S. Army Engineering Corp.

New Sales Manager for Wood. Chas. R. Hine has been appointed general sales manager for Wood Manufacturing Co., North Hollywood, Calif. Mr. Hine has 30 years of experience in the sales and merchandising of heavy construction equipment, including sales direction for the H. W. Moore Equipment Co. of Denver and more recently as vice-president and sales manager of Le Roi-Rix Machinery Co. of Los Angeles.



Chas. R. Hine

Caterpillar Forms British Subsidiary. Announcement of the formation of Caterpillar Tractor Co., Ltd., a wholly owned British subsidiary, has been made by Lewis B. Neumiller, president of Caterpillar Tractor Co., Peoria, Ill. The new company will engage in the business of procuring, inspecting, storing and shipping British-made genuine "Caterpillar" parts to the company's dealers in United Kingdom and other countries. Wallace J. Bornholdt, purchasing agent for Caterpillar will head the new English organization as managing director.

Fitz Named Sales Representative. Donald D. Fitz, Des Moines, Iowa, has been named Iowa sales and service representative for the D-A Lubricant Co., Inc., Indianapolis, Ind.

New Warco-Hercules Distributor. The Ruffridge-Johnson Equipment Co., 250 10th Ave., South Minneapolis, Minn., has been appointed distributor for the state of Minnesota by W. A. Riddell Corp., Bucyrus, O., for Warco motor graders and Hercules road rollers.

McCulloch Motors Promotions. Jean St. Henri and Kenneth Mulkey have been promoted to posts as factory sales representatives for McCulloch Motors, Los Angeles, Calif. Both have been members of the concern's service department, St.

Henri for the past three years and Mulkey for the last two years.

New Sales Manager for Pioneer.

Carl R. Rolf, heretofore assistant sales manager has been appointed assistant secretary and sales manager of Pioneer Engineering Works, Minneapolis, Minn. He was district sales representative for the western states prior to his appointment Jan. 1, 1940 as assistant sales manager.



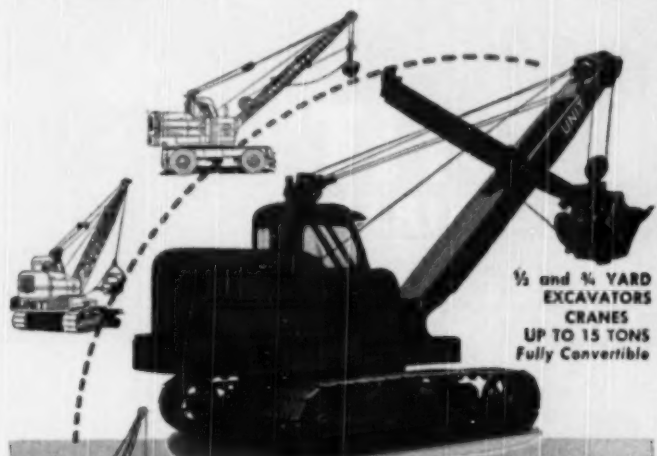
Carl R. Rolf

Koehring Establishes New Sales Activity.

Sales of Koehring, Parsons and Kwik-Mix construction equipment in Northern California and Nevada will be handled from the Koehring Company West Coast Division office in Stockton, Calif. Leo J. Lamley, formerly Koehring district representative for the west coast area, will be in charge of sales for all products produced by Koehring and the two subsidiary companies. A complete stock of repair parts and service also will be



L. J. Lamley



**1/2 and 3/4 YARD
EXCAVATORS
CRANES
UP TO 15 TONS
Fully Convertible**

UNIT BUILT FOR
ALL-AROUND
Heavy-Duty Service


UNIT is tough! UNIT is versatile! That's why you can use UNIT on any type of job requiring shovel, clamshell, magnet, dragline, trencher, grapple or backfiller. And it's easy to change from one attachment to the other, right on the job. UNIT gives you all the power and speed you need, plus these exclusive features: Automatic traction brakes . . . Disc-type clutches . . . Drop forged alloy steel gears . . . Splined shafts . . . One-piece cast gear case . . . Straight-line engine mounting. Mobile and Crawler Models Available

UNIT CRANE AND SHOVEL CORP.
4407 W. BURNHAM ST., MILWAUKEE 14, WIS., U. S. A.

FULL VISION CAB
for
GREATER
SAFETY



UNIT



**DIETZ
LANTERNS**

**BRIGHT
or LOW
—and
constantly so**

**LIGHT
AS DESIRED**

R.E. DIETZ COMPANY
EST. **SYRACUSE, N.Y.** 1840

NOW!

**ORDER
BY NUMBER**



*The Tenth of a Series in the interest of more efficient
use of steel . . . a vital American resource*

**...THE NEW,
EASY WAY
TO SPECIFY**

LACLEDE Multi-Rib Reinforcing Bars

ROUND BARS in all sizes . . . to meet latest ASTM A305 Specifications . . . conveniently marked to make your specification job easier. And, of course, improved Laclede deformations mean uniform reinforcement strength, maximum anchorage — plus a more efficient use of steel by eliminating hooks and shortening embedment lengths.

**TABLE OF
ASTM
A305
SPECIFICATIONS**

Bar No. in. dia. in. ft.	NOMINAL DIMENSIONS ROUND SECTIONS			REQUIREMENTS OF DEFORMATIONS		
	Deformation inches	Clear Section Bar Sq. inches	Perimeter inches	Max. Avg. Spacing in.	Min. Height inches	Max. Gap inches
21	0.187	0.250	0.03	0.785	—	—
3	0.376	0.375	0.11	1.178	0.262	0.015
4	0.468	0.500	0.20	1.571	0.350	0.020
5	1.043	0.625	0.31	1.963	0.437	0.028
6	1.502	0.750	0.44	2.356	0.526	0.036
7	2.044	0.875	0.60	2.749	0.612	0.044
8	2.670	1.000	0.79	3.142	0.700	0.050
9	3.400	1.128	1.00	3.544	0.790	0.056
10	4.303	1.270	1.27	3.990	0.889	0.064
11	5.313	1.410	1.56	4.430	0.987	0.071

*Bar numbers are based on the number of 1/8 inches in the nominal diameter of the section.

†Bar number 2 in plain rounds only.

‡Bars numbered 9-10-11 correspond to former 1" sq., 1 1/8" sq., and 1 1/4" sq. sizes, and are equivalent to these former standard bar sizes in weights and nominal cross-sectional areas.

§Chord of 12 1/2% of Nom. Perimeter.



LACLEDE STEEL COMPANY

St. Louis, Mo.

"For the BEST
in Reinforcing Steel . . .
Specify Laclede"

maintained in Stockton. The personnel force will be increased in the near future.

Hunkle Appointed Assistant Sales Manager. H. J. Hunkle, Jr., has been appointed assistant manager of sales engineering division, Caterpillar Tractor Co., Peoria, Ill. He joined Caterpillar in 1947 and worked as district representative in the eastern sales division and more recently as special representative in the sales development division.



H. J. Hunkle, Jr.

Hyster Appointment. C. E. Houston has been appointed manager of the recently opened retail store in Peoria, Ill., for the industrial trucks of Hyster Co., Portland, Ore.

New Huber Export Manager. George A. Howser has been appointed export manager of Huber Manufacturing Co., Marion, O. He succeeds Willis R. Nye, who resigned to enter church missionary work in India.



G. A. Howser

Mr. Howser joined Huber in April, 1948 as district sales manager with headquarters in the main office. Previously he had 8 years experience in industrial sales.

New Distributors for Republic Rubber. The following have been appointed distributors for Republic Rubber Division: Lee Rubber & Tire Corporation, Youngstown, O.; Southern Marine & Supply Co., 10 East Bay St., Savannah, Ga.; Wetzel Equipment Agency, 375 South West Temple, Salt Lake City, Utah.

Frizzell Appointed Sales Manager. Richard H. Frizzell has been appointed sales manager of the structural products department of the Wickwire Spencer Steel Division of The Colorado Fuel and Iron Corporation. His headquarters will be at 361 Delaware Ave., Buffalo, N. Y. He succeeds G. L. Crawford who will devote his full efforts as sales manager of Division's Buffalo sales district.

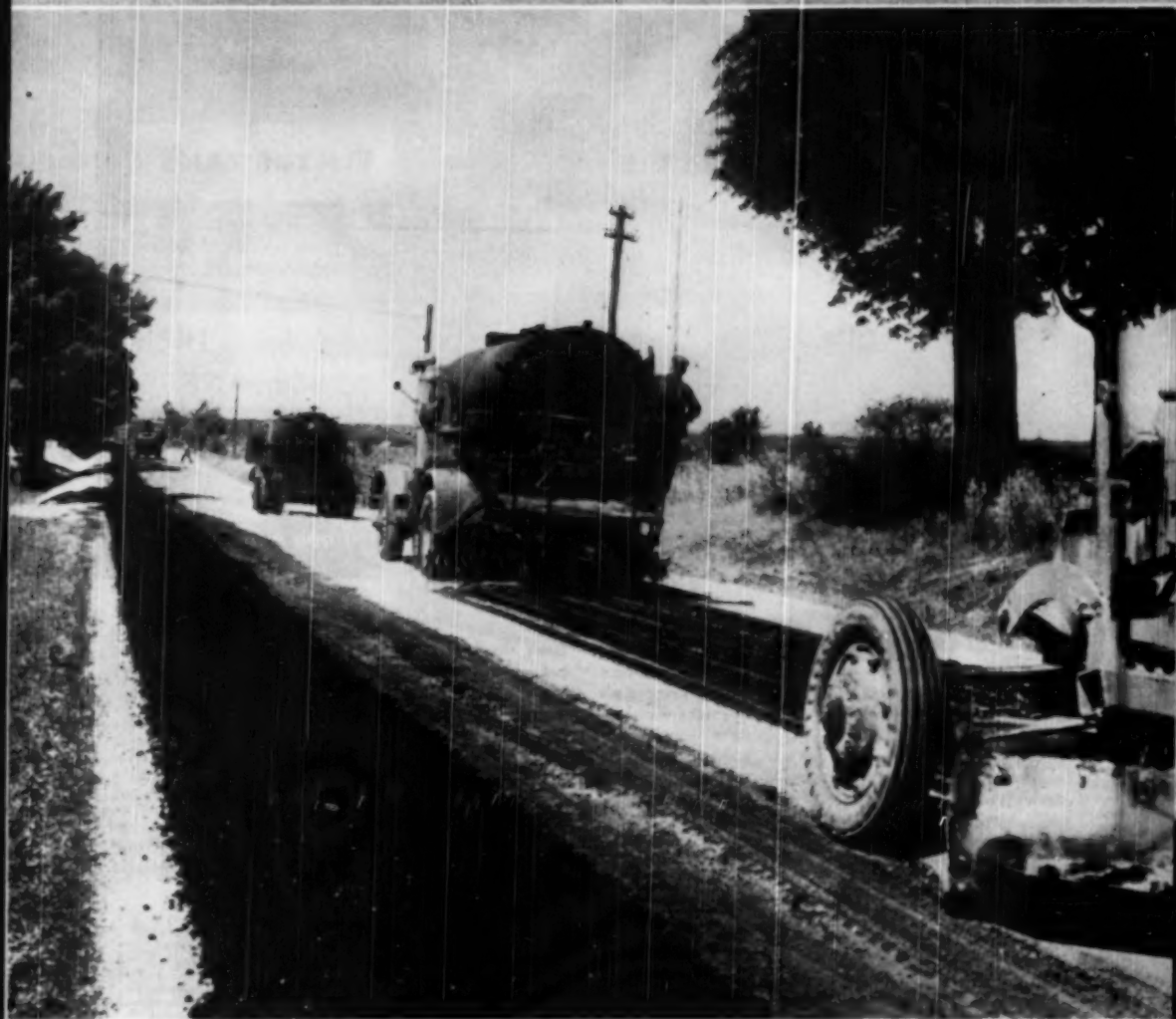


R. H. Frizzell

Gradall Moves to New Philadelphia. Manufacture of the Gradall multi-purpose earthmover, has been transferred from the Cleveland plant of The Warner & Swasey Co., to a plant leased by the company in New Philadelphia, O. A separate Gradall Division plant will permit more economical production of the machine, and will simplify the planned doubling of 1951 production schedules.

Bituminous

ROADS AND STREETS



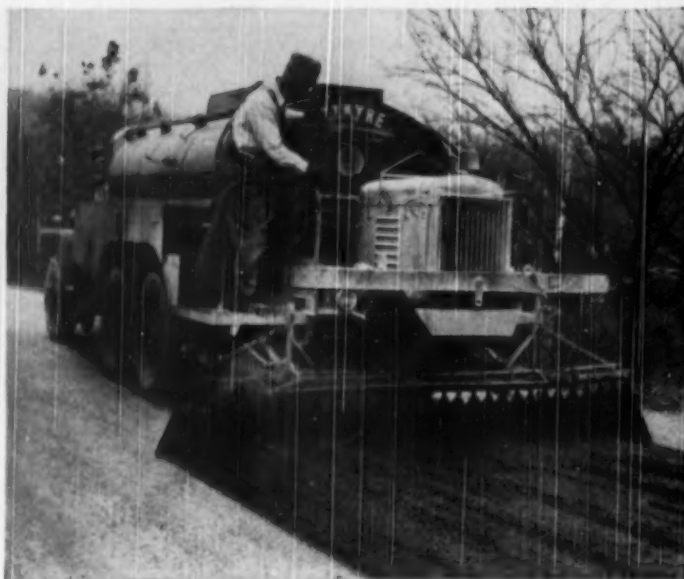
SEPTEMBER, 1950

Blade-Mix in Oconto County, Wisconsin

Seen in operation here is a modern equipment train consisting of three motor graders, two pulverizing mixers and two bituminous distributors. The County's forces work about a mile of road at a time with successive round-trip passes, keeping a blade immediately behind the distributor so that traffic threading through the job never has to pass over exposed oil.

(See page 87 for beginning of timely articles on bituminous subjects)

WHY YOU GET IMPROVED HEATING, BETTER ROADABILITY, EQUALIZED LOAD DISTRIBUTION



Etnyre Tank is a
long, low oval

ETNYRE TANK

Circulating System
BELOW Tank

Short, High
TANK

Circulation
System

Circulating System
on level with and
at one end of Tank

Get the Facts! Here is an exclusive Etnyre feature of interest to every owner and operator of a bituminous distributor. It's the secret of Etnyre's success in building the finest spraying mechanism known today.

On a Tank of any capacity, on any given cab to axle, Etnyre uses a longer Tank with a lower center of gravity. This is possible because the Etnyre Circulating System is located **BELOW** the Tank. The results are:

Improved heating...more flue area per gallon of material—longer Tank allows for smaller oval, longer flues—less distance for heated material to travel from

flues throughout load. Stack temperature reduced because of faster dissipation of heat through material.

You get *better* roadability—the lower center of gravity makes possible faster, safer traveling speeds to and from the job—also improved appearance.

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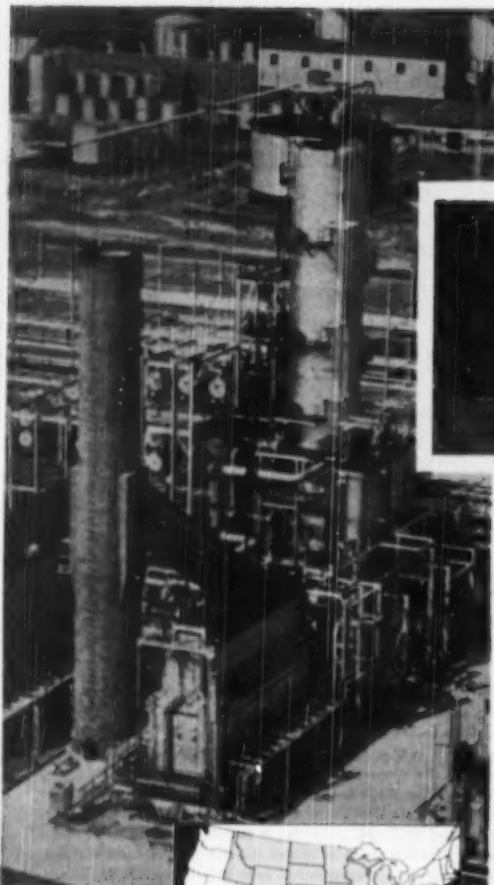
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3-Foot-Thick

Flexible Pavement Design Alternate Planned for New Jersey Turnpike

Pavement design committee recommends bituminous alternate design based on unprecedented design load of 36,000 lb. per axle

By Walter R. Macatee

Special Correspondent to Roads and Streets

HIGHWAY pavements three feet thick may become a reality if bituminous-type construction is used on the 118-mile New Jersey Turnpike. Under a suggested policy of calling for bids on alternates of concrete or bituminous pavements of comparable service value, a flexible pavement design calling for 36½ inches of compacted or supercompacted layers may be required over poor soils.

This design is according to recommendations covering both flexible and rigid pavement designs, recently submitted by a committee of consultants. This unusual thickness, plus close control of the quality of each layer in the pavement structure, is contemplated to assure at least 35 years' useful service. The New Jersey Turnpike's anticipated traffic is expected to be unprecedentedly heavy.

The New Jersey design represents an advance over any previous arterial roadway design adopted in the United States. It marks a continuation in a long-time trend toward heavier and more adequate pavements—a far cry from the rule of thumb black-top designs of not-so-many years ago, which included perhaps six or eight inches of gravel and an inch of two of bituminous carpet.

Thickness and high quality of materials are not the sole criteria on which the pavement committee based its reliance. Other criteria are adequate thickness and high density of each of the component layers. To avoid any possible settlement failures, the committee recommends that the subgrade, in both cut and fill sections,

Mr. Macatee is Highway Transport Specialist with the Civil Aeronautics Administration in Washington. He was formerly Washington representative for the Asphalt Institute. He has long been a vigorous advocate of conservatism in the design of flexible pavements to assure them having long life on airfields and highways when heavy, dense traffic would be encountered, to thereby extend the acceptance of such pavements for heavy-duty service.

shall be compacted to 95% when measured by the Modified AASHTO Standard. To be certain of securing long-life pavements, this unusual density is required for a depth of four feet, or more, below the top of the finished pavement. To make doubly sure of good results, and that no future settlement of pavements occur, any fills constructed below the subgrade bottom must be densified almost as tightly as the upper four feet, to 90% of the Modified AASHTO test.

Very Heavy Rolling

To assure accomplishment of these results, recommendations call for compaction with rollers having wheel loads equal to, or greater, than loads which will ultimately use the Turnpike. The engineering board suggests multiple wheeled rollers "having a load of not less than 25,000 lb. on each tire." This probably means a total axle load of 100,000 lb. Aside from such a roller's principal function of securing high density of materials which compose pavement's layers, it would also serve to pre-test the road-bed structure. If any soft places are revealed under such heavy weights, the board insists that the materials adversely affected must be removed, and replaced with selected and entirely suitable materials.

Throughout the entire depth of the pavement structure—36½ inches—the Turnpike Authority is urged to use nothing but frost resisting materials. Even in the lower portion of the subgrade, these materials shall be graded so that not more than 10% passes a 200-mesh sieve. Materials throughout must have a Plasticity Index not greater than 6. In the upper 6-in. portion of the subgrade, the material which may pass a 200-mesh sieve is limited to 6% with P. I. not exceeding 3. Everything above that point must be composed of materials having a P. I. of zero.

The sub-base component recom-

mended to overlie the subgrade is to be of selected materials having 6 in. compacted thickness placed in two 3-in. layers, while sub-base materials is required to be reasonably uniform; local bank-run uncrushed gravel would usually meet the board's requirements. As much as 50% may pass the No. 4 sieve. The board recommends sufficient fines to bind the other particles together to almost a solid mass under the action of heavy rolling, and proper quantities of moisture.

The top 12½ in. depth of pavement, as shown in the cross-section, would consist of an 8-in. base and 4½-in. of bituminous top. The base, placed in three layers, shall be composed of crushed rock or crushed gravel water-bound macadam having at least 85% of fractured surfaces. The two Macadam layers shall consist principally of 2½-in. max. materials, filled with fines ranging up to ¾-in. crushed materials. The 2-in. penetration macadam layer shown as the third base layer is to be composed of crushed stone which, in general, passes the 1½-in. sieve, plus fines up to about the ¾-in. size.

All of the aggregate materials composing the 8-in. base is required to have a loss no more than 35% when subjected to the Los Angeles Test. The loss may not exceed 12% when

Feature Article Next Month on New Jersey Turnpike

The \$220,000,000 New Jersey Turnpike — most advanced as well as elaborate and costly highway project yet conceived in the United States—will be the subject of a full-dress summary by Col. V. J. Brown of the *ROADS AND STREETS* editorial staff.

Planning, design, construction, liaison and legal problems and methods will be authoritatively covered by Col. Brown, whose articles on the Pennsylvania Turnpike at the time of its original construction in 1939 and 1940 are still regarded as the "definitive" reports on that history-making project.

subjected to five cycles of the Sodium Sulphate Test. This assures having high shear resistant material. The quantity of 120/150 penetration asphalt in the 2-in. penetration course is set at approximately 1½ gal. per sq. yd.

Heavy Asphaltic Concrete

Aggregates for the 2½ and 2-in. hot-mixed asphaltic concrete layers may lose no more than 10% when tested for soundness, using the Sodium Sulphate Test. Close gradation requirements cover both binder and surface courses.

A light colored seal coat is specified for visibility purposes. This layer is recommended to consist of about 0.2 gal. per sq. yd. of emulsified asphalt, and "white quartz sand, crushed limestone, marble or granite" installed at the rate of about 12 lb. per sq. yd.

The Turnpike's pavement committee, in its final report, gave no data pertaining to pavement costs of either rigid or flexible types which were recommended as suitable for the Turnpike. However, based on available information of countrywide average costs of flexible and rigid pavements, one can estimate the cost of the committee's recommended flexible section. Based on such data, the average cost of the flexible type recommended for consideration would be \$5.29 per square yard, as above.

Actually, where subgrade materials might need to be imported for use over poor foundation subsoils, such materials would be installed and compacted by the grading contractors. The item

	Per Sq. Yd.
Light colored Seal Coat, Emul. Asp.	\$.12
4½" Plant-Mix Asphalt Concrete @ \$18.66 cu. yd.	1.71
2" Stone Layer for Pen. Mac. @ \$7.20 cu. yd.	.80
1½" Gal. Asp. for above @ 12c gal.	.20
6" Waterbound Mac. @ \$7.20 cu. yd.	1.20
6" Sub-Base, Local Gravel @ \$4.50 cu. yd.	.50
18" Hauled-in Subgrade Material @ \$1.50 cu. yd.	.58
Total	\$5.29

of 90 cents for subgrades would not appear as part of the paving cost. Therefore, the net cost of a flexible pavement, as likely to be reflected in bids submitted for paving exclusive of subgrades, will probably average \$4.39 per sq. yd. The grading of the Turnpike is now in progress, and paving is scheduled to begin late this year or early in 1951.

(The engineering pavement committee also recommended for consideration the same type of subgrades under rigid pavements; however, increasing the subgrade's thickness to 20 in., plus a 6-in. sub-base to underlie a 10-in. reinforced concrete surface. Therefore, for purpose of computing probable competitive advantages of one of the two forms of paving recommended, the item of subgrade-costs need not be considered, being about the same under either type of surfacing. Inasmuch as the current average cost of rigid pavements is approximately \$15.12 per cu. yd. of concrete, in place, including reinforcing steel, the alternate form of paving suggested for consideration, would likely be \$5.05 per sq. yd. This, as indicated, would

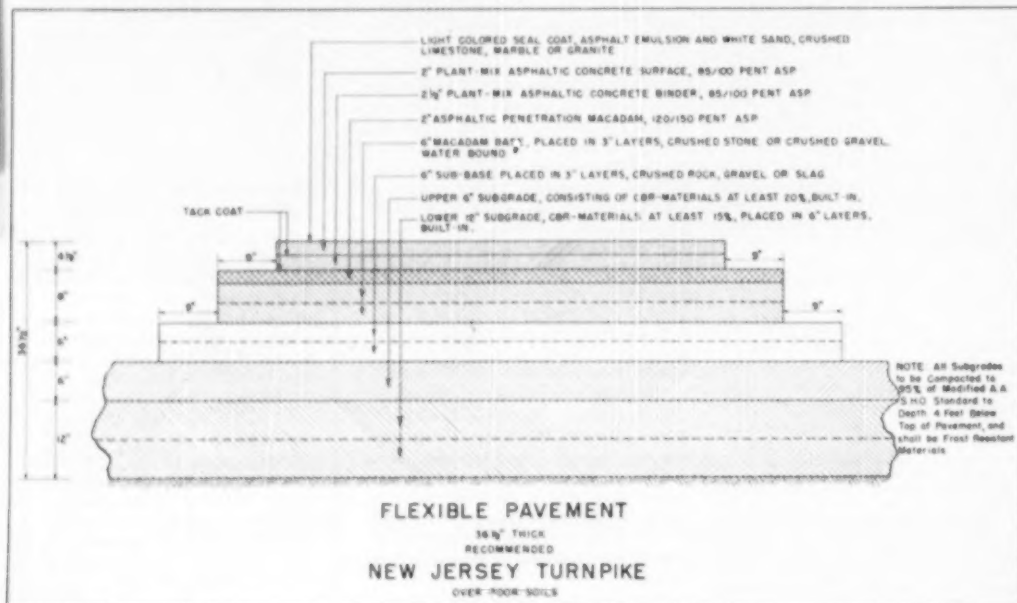
be exclusive of the cost of hauled-in subgrades, where needed, but would include a sub-base 6 in. thick recommended by the Turnpike's paving committee for use under this form of pavement. (This estimate is unofficial.)

Load Repetition Factor

The flexible roadway design recommended for the New Jersey Turnpike is thicker than that employed for airfields based on much heavier design aircraft wheel loads. However, it must be remembered that airfield thickness requirements, established for World War II by the Army Corps of Engineers and Civil Aeronautics Administration, are based on fewer repetitive loadings than will be encountered on the Turnpike.

Army engineers have called for total thickness of only 17 in. of flexible pavements for single airplane wheel loads of 37,000 lb. when subgrades consisted of soils having a California Bearing Ratio as low as 10%. The New Jersey design for highway loads of 36,000 lb. per axle, (two wheels or more) requires more than twice as much thickness when existing subgrades have a CBR-value of the same rating, or 10%.

Considering the engineering talent and integrity of the Turnpike's consultants, it is unlikely that opposition from numerous advocates of flexible pavements—such as that which rose up against requirements for airfield pavements—will again arise to doubt the wisdom of specifying sufficient quality, volume and density of materials to assure long life of flexible





★ Spreading oil mix for the new gutter section through the town of Adams, Wisconsin.

Blade-Mix Gutter Section

—Answer for Widening Job through Small Towns

pavements for heavy-duty highway use. No one can question the validity of the New Jersey design recommendation, considering the severity of the traffic and subgrade conditions.

Competitive Question

In light of analysis of probable competitive positions of both flexible and rigid pavements for use on the Turnpike, it seems likely that favorable consideration will be given to seeking bids on both pavement forms recommended for study by the Turnpike Authority. And it seems unlikely that influential advocates of flexible pavements within that industry who opposed the Army engineers' conservative design for airfields will again make the mistake of assuming a defeatist attitude that they are being "priced out of the market" in event their type is allowed to compete for paving the Turnpike. Nor does it seem probable that the critics of conservatism in the design of airfield and highway pavements would, in the light of the poor behavior of relatively thin pavements under heavy, dense truck traffic, subject themselves to the danger of again being wrong in opposing conservative pavement design for heavy-duty traffic such as will obtain on the Turnpike.

The member of the Committee which submitted pavement recommendations, and the engineering concerns with which they are associated, are:

BLADE-MIXED bituminous materials were used recently to widen US 13 through the small towns of Friendship and Adams, in central Wisconsin. The widening consisted of adding a shallow 13 to 15 ft.-wide gutter section on either side of the existing two-lane concrete road paving.

The two communities closely adjoin each other and are strung out along this highway, which is one of Wisconsin's principal north-south routes. The situation was the familiar one of a rural-type road traversing the business blocks and outlying residential

stretches. The concrete paving included street-type, full-width construction along only a small part of the distance. Elsewhere the strip between pavement and property line was merely graveled, which proved a source of mud and dust and of troublesome erosion during storms.

The project set up by the Wisconsin highway commission called for replacing the graveled strips with bituminous paving totaling about one mile in length along either side. The new strip was designed as a combination gutter section and parking lane. There is a 10 ft. uniform-width slope from the road paving to the gutter, and a backslope varying from 3 to 5 ft. in width. Transverse slopes on either side of the gutter line were not made uniform but were varied to fit a designed gutter gradient. New storm drain connections and inlets were required in connection.

New Gutter Design

The new pavement consists of 6 in. compacted thickness base of crusher-run gravel, and 2 in. thickness of oiled gravel. The oil mix was made with 16 gal. per cu. yd. of SC-6, applied cold to a 65-35 gravel-sand mixture graded to $\frac{3}{4}$ -in. maximum. A seal coat is expected to be placed after a year or two of service.

About 1500 cu. yd. of oil mix and 3,000 cu. yd. of base gravel were required.

O. J. Porter, Chairman; Edwards & Kelcey, Frederick R. Harris, Inc., & O. J. Porter & Co.

John R. Dietz; Gannett, Fleming, Corddry & Carpenter, Inc.

J. K. Knoerle; J. E. Greiner Co. W. L. Hyland; Fay, Spofford & Thorndike.

Elmer K. Timby, Vice Chairman; Howard, Needles, Tammen & Bergendoff.

Douglas R. Sayers; Parson, Brinckerhoff, Hall & MacDonald.

C. E. LeLeuw; LeLeuw, Cather & Co.

General W. W. Wanamaker is the Executive Director of the New Jersey Turnpike Authority, and Charles M. Noble, formerly Chief Engineer of the New Jersey State Highway Department, is Chief Engineer.



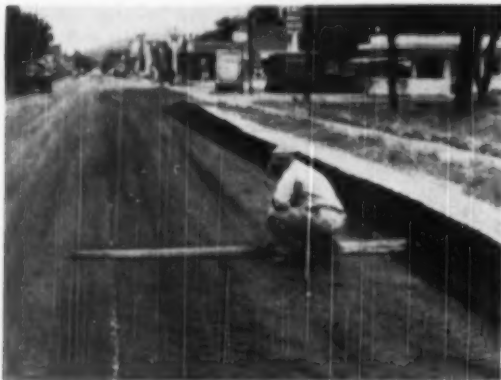
★ The mixing was done in a windrow 1,000 ft. long in a side street, and mix dispatched by loader and trucks to the job after curing.



★ Thorough rolling was considered an important part of the job. Rolling was conducted over a large area of work, due to the slow cure materials.



★ A section of widening completed except for final touching up and re-rolling. A "road through town" transformed into a broad city street with controlled drainage.



★ Special slope testing straight-edge being used by patrol superintendent Charles Simon.

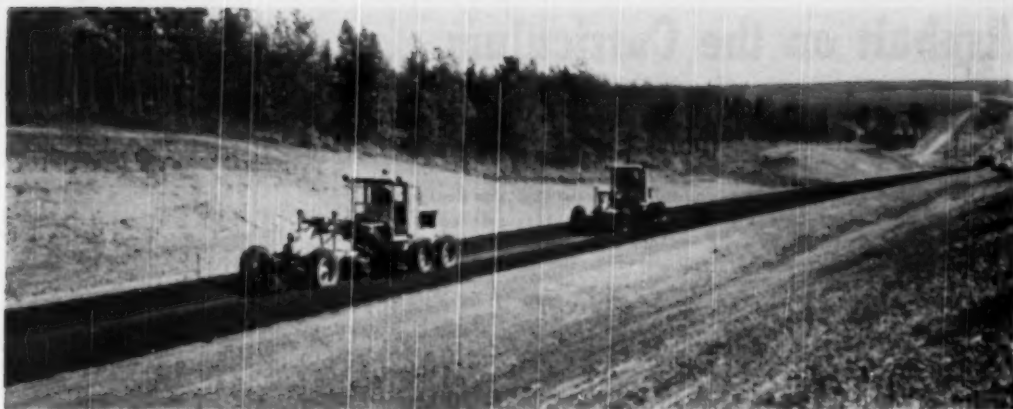
The work was performed by the maintenance forces of the Adams County highway department. Crushed materials for base and mix were produced in the county's pits, employing a Pioneer mobile crushing and screening plant, a Badger plant with Universal primary crusher, Osgood $\frac{1}{4}$ -yd. shovel, a FWD truck and several IHC trucks.

Aggregate and oil were blade-mixed in a 1,000-ft.-long windrow using a little-traveled residential side street, the mixing and processing being performed with a Warco grader and a Rosco bituminous distributor. A Reece loader with Minneapolis-Moline tractor mounting loaded out trucks to the job, where the Warco grader spread and a Galion 8-ton tandem roller thoroughly consolidated the mix. The roller operator cross-rolled the gutter sections, followed by passes along the axis of the work.

Warping in Gutters

A field problem solved nicely by the engineer was the warping in of the constantly changing gutter slopes. The required rate of slope for each side of the gutter was computed for points at 50-ft. intervals along the work, and these slopes set and checked using a specially built slope template. This template (pictured) was made by fastening two 10-ft. straight-edges together by a pin at one end and an adjustable sliding clamp at the other. A carpenter's level bubble was set in the top stick. The two sticks were spread and clamped in such a position that when the lower stick was laid on the desired slope, the top stick would be exactly level.

August Hamstengel is county road commissioner of Adams County, Wisconsin. Charles Simon, patrol superintendent, represented the county on the job.



★ The 11-mile bituminous road-mix job was completed in 20 days, requiring a 10,000-gal. rail tank car daily.

Heavy Flexible Bituminous Roadbed Designed for Swamp

AN eleven-mile relocation project recently completed in northern Wisconsin affords a typical example of swamp road methods found successful in the region. The project is located on Highway 63 between Ashland and Grandview, in Bayfield County.

The road through this area is actually supported by the tremendous side and upward pressure of Marshland muck many feet below the road surface. Thousands of tons of marsh material was excavated and earth fill was dumped into what seemed a bottomless pit. The fill continued to sink until the pressure from all sides was equal to that from above.

20 Working Days

In August 1949, Bayfield County undertook the bituminous surfacing of the road as a Federal-aid construction job. Previously two years had been spent in sub-grading, marsh excavation, building bridges, and placing a 12-in. sand-gravel fill or ballast on the subgrade, covered by about 3-in. depth of crushed gravel and then primed with Wisconsin SC-6 road oil. The road was opened for traffic through one winter, then lifted with 6-in. of crushed gravel and primed again with SC-7 road oil. Upon this base was laid a 3-in. bituminous surface course using the blade-mix method. Considerable irregular subgrade settlement is still taking place in the excavated areas.

This work involved the use of 168,

000 gal. of Wisconsin type SC-7 asphalt for 11 miles of blade-mixed surfacing and was accomplished in about 20 working days during August, 1949. It was necessary to heat, unload, haul, apply, mix and finish approximately one 10,000-gal. railroad car of bituminous material each working day.

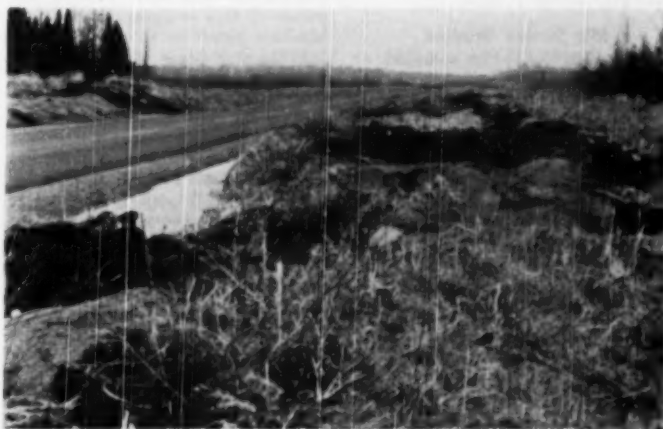
Equipment used consisted of 1 tank car heater (Bros steam boiler); 1 booster (Bros direct heater and pump); 3 1000-gal. insulated supply tank trucks; one 1000-gal. insulated Rosco distributor with a 12-ft. spray bar, mounted on a GMC 6x6 chassis;

8 Caterpillar D12 motor graders for mixing and placing; one Gallion 10-12-ton tandem roller for finishing; plus small tools. A Cedarapids mobile crushing plant supplied the aggregates.

About 1200 cu. yd. per mile of dense graded crushed stone was windrowed upon the primed base. This windrow was then spread gradually in about $\frac{3}{8}$ -in. layers and each layer sprayed with hot (190 deg. F.) asphalt Wisconsin type SC7 followed immediately by motor graders mixing and again windrowing the material. This process continued until approximately 13 gal. of bitumin per cu. yd. of crushed stone was incorporated in the mix, usually requiring 10 to 12 lateral movements across the roadway to properly mix the aggregate.

The moisture content of the gravel affected the mixing time considerably.

(Continued on page 100)



★ The black stuff on the berms is excavated muck, placed alongside the roadway as counterweight.

Asphalt on the Curriculum at Oklahoma A. & M.

Two courses cover bituminous materials and the design and control of mixes. Extension short courses offered to practicing engineers over the state. College also active in asphalt research.

By J. Rogers Martin

Research Professor, School of Civil Engineering, Oklahoma Institute of Technology, Oklahoma Agricultural and Mechanical College, Stillwater, Oklahoma

WIDE interest has been shown in asphalt courses now offered by the Oklahoma A. & M. College. We are giving two such courses. Following is a description of each course:

C. E. 431: Bituminous Materials. This is a one-hour Senior course dealing entirely with the various types of asphalt. It is set up in the catalog as a laboratory course meeting three hours per week. However, about one-third of the time in this course is spent in lecture.

In this course the students are required to run all of the principal asphalt tests. In the lectures considerable stress is placed on the function of each individual type of asphalt and criteria for the selection of the asphalt type for a given condition. At the present time the text books employed are "The Asphalt Institute Handbook" and Report of ASTM Committee D-2, "ASTM Standards on Petroleum and Lubricants." The prerequisites for the course are a two-hour course in highways and a four-hour course in soils.

Mix Design Studied

C. E. 572: The Design and Control of Asphalt Mixes. This is a two-hour graduate course consisting of one hour lecture and three hours of laboratory per week. The lectures cover the basic principles of all types of asphalt pavements including hot mix, seal coats, surface courses, soil-asphalt bases and mixes employing liquid asphalts. Considerable time is given to discussions of prevailing design and construction practices for each type of pavement. At least one trip is made each semester to a large asphalt pavement project so that the students may become acquainted with the various types of equipment employed, etc. I have found that it is advantageous to take these trips in the early part of the course so that the discussions on construction meth-

ods will have more significance for them.

In the laboratory a complete design for a hot-mix pavement is carried out in all details. This includes selection of the aggregates to be employed (the student is required to make the grading analysis on several aggregates and then select the aggregates to be used from these), determination of specific gravities of aggregates, per cent density of molded specimens, selection of optimum asphalt content, determination of Hveem stability and an extraction of one of the specimens to determine the actual asphalt content and grading.

In addition to the complete design of hot mix the students bring in a sample from a failing pavement, run complete analysis to determine as-

phalt content, grading and per cent density of the pavement. The students are required to issue a report giving their diagnosis of why this pavement failed.

The text books being used at the present time are "The Asphalt Institute Handbook" and various bulletins on asphalt which have been issued at the college.

After teaching these courses for three years I have come to the conclusion that it would be advantageous to combine these two courses into one three-hour course with two hours lecture and three hours laboratory per week. This is because a student taking C. E. 431 without taking C. E. 572 does not obtain a full introduction into asphalt paving. It all goes back to the principle that a little learning is sometimes a dangerous thing.

Hugh Wallace, district engineer of the Southwest Division of the Asphalt Institute, and myself are now preparing a text entitled "Design, Control and Construction of Asphalt Pavement," which is designed to cover the material in these two courses independently, so that no handbooks, manuals or bulletins will be required. The first draft of the text is now about 60% complete and it is expected that we will have a complete draft in mimeographed form by the beginning of the fall semester.

Texas A. & M. Has Carried Asphalt Course for 30 Years

The Civil Engineering Department at Texas A. and M. College, College Station, has been teaching a Senior elective course in Bituminous Materials (C.E. 417) for over thirty years.

According to Fred J. Benson, professor of civil engineering, the bituminous materials course presently consists of 2 hours of lecture and 3 hours of laboratory work per week. The course covers two phases; the first deals with bituminous binders. In this phase the source, methods of production, methods of testing, significance of test methods and specifications for petroleum asphalts, tars, native asphalts and rock asphalts are covered. The laboratory work consists of performing a number of the routine tests on asphalts and tars.

The second phase deals with the design and construction of bituminous pavements. Surface treatments, penetration macadam, road mix and plant mix types are covered in some detail. Laboratory work consists of a visit to a surface treatment project and the actual laboratory design of a plant-mix type of pavement. The men are

introduced to the Extraction Test, Specific Gravity Test, and to the Hveem, Hubbard Field and Marshall Stability Tests.

Graduate course C.E. 626, Advanced Highway Design consisting of 3 hours of theory and 3 hours of laboratory per week about 8 weeks is devoted to flexible pavement design with considerable emphasis on the design of the bituminous surface.

Graduate course C.E. 637 consisting of 1 hour of theory and 3 hours of laboratory per week is a Study of Bituminous Paving Mixtures in which special problems in paving mixture design are taken up. The exact course content is varied to fit the background of the student.

"Our Bituminous Materials Laboratory is well equipped and we are quite proud of it," notes Professor Benson.

"We have not been doing any extension teaching in the field of highways in recent years. My feeling is that there is a wide open field for such activities in this state for the purpose of training our county road organizations."

After using it for one semester, it is our plan to revise it, as necessary, for publication.

Two Short Courses

Asphalt short courses for practicing engineers are also given through the Engineering Extension Division of the college. This is under the direction of M. L. Powers.

One is a one-week course (5 days, 6 hours per day) dealing with asphalt pavements and designed for the engineer-level. About half the time is spent in lab and about half in lecture and discussion. The material covered is essentially the same as that for C. E. 572, but I act in the capacity of a discussion leader rather than a lecturer. This has been a rather popular course in Oklahoma and the surrounding states, having been attended by engineers from cities, counties and the Oklahoma Highway Department, consulting firms, oil companies, contracting firms and the U. S. Army.

The other course is of two weeks' duration (10 days, 6 hours per day) for asphalt inspectors. Stress is placed on testing, field inspection and construction techniques. The time is divided about half and half between lecture and lab.

To round out our asphalt program we are carrying on an asphalt research program through the Engineering Extension Division, which is under the direction of Dr. Clark Dunn. At present our major efforts are being expended on a co-operative project with the Oklahoma Highway Department on Soil-asphalt. Other projects in progress include several being carried out by graduate students, a departmental project on weathering of asphalt pavements.

The 3-phase asphalt program—student instruction, short courses and research—was instigated by Professor Ren G. Saxton, Head of the Civil Engineering Department, Prof. Powers and Dr. Dunn in 1947, at which time I joined the Civil Engineering staff. Instruction and direct supervision of research are being carried out by myself and Woodrow W. Baker who joined the staff in 1949.

Soils vs. Asphalt

In view of the close relation between soils and asphalt pavements, we consider our soil courses and asphalt courses as forming an integrated study of flexible pavements. In other words, it is difficult to divorce soils from any kind of study of asphalt pavements. Two courses are offered in soil mechanics. One is a four-hour senior course dealing with soil fundamentals; the other is a four-hour graduate course dealing

with such topics as flow nets and consolidation.

Short courses for practicing engineers are also given in soils. These courses are slightly different from the student courses in that more time is spent on the direct application of fundamental soil principles. Research is also being carried out in soils.

The instruction and supervision of research in the soil program is carried out by professors R. E. Means and W. H. Hall.

Asphalt Institute Appoints District Engineer

William H. Rhodes has been appointed district engineering representative for The Asphalt Institute, New York, N.Y., to cover the states of Louisiana and Mississippi more intensively. Mr. Rhodes will assist William H. Mills, district engineer, who, from his office in the Mortgage Guarantee building in Atlanta, directs the local engineering activities of the Institute in that part of the southern area which includes the states of Alabama, Florida, Georgia, Louisiana, Mississippi, South Carolina and Tennessee. Mr. Rhodes' engineering career includes long service in the highway building and maintenance field. He served as a junior civil engineer with the U. S. Bureau of Public Roads and then, after extended engineering war service in France, was promoted to the position of senior highway engineer of the Bureau in charge of Federal Aid in road construction in Louisiana. Later, as maintenance engineer for that state he organized its first maintenance department. Then followed, prior to his present Institute appointment, 22 years outside of government service, very effectively employed in the highway building industry. Mr. Rhodes has been active in Louisiana engineering societies being president of the local post of American Society of Military Engineers, president of Louisiana Section American Society of Civil Engineers, and president of the Louisiana Engineering Society.

Defense Needs Set Arterial Road Costs Congress Told

NATIONAL defense rather than heavy truck use dictates design standards and construction costs of highways; and one great national transportation need is relaxation of undue regulation of other forms of transportation in meeting highway competition.

These two major concepts were presented by Public Roads Commissioner Thomas H. MacDonald before the Sen-

ate Subcommittee on Domestic Land and Water Transportation in a recent hearing. MacDonald declared that "the minimum requirements of structural and capacity design of the major routes to serve national interests must be equated to the foreseen needs of the national defense. Thus the question of whether the highways could be built at less cost if there were no heavy trucks becomes largely academic since the design of major routes must be held to defense standards. The exploration of the subject of truck transportation over the highways thus becomes one of overloading and misuse of improved highways."

The most important question of national policy, he said, is the freeing of other forms of transportation from uneconomic regulation and restrictions upon initiative in meeting the competition of highway transport. In this connection he declared that "the major problem of competition realistically stated lies in the private ownership and operation of 36 million automobiles with a capacity at one time sufficient to move the entire population and likewise of at least 7 million trucks. Privately owned automobiles and trucks are not subject to regulation or control as public utilities."

Other highlights of Mr. MacDonald's lengthy statement included his conviction that, since highway transport is made up of many classes of operations, sound conclusions cannot be generalized. He indicated that the motor vehicle has sometimes unjustly been held responsible for changes in traffic patterns that have resulted to the disadvantage of the rail lines. The overlapping margins of actual competitive operations in the transport of the several classes of freight by highway and rail, involve a relatively small percentage of motor trucks now in use, he pointed out.

New AASHO Edition on Geometric Design

Released recently by the American Association of State Highway Officials (National Press Building, Washington, D.C.) is a new, handy one-volume edition of the Association's "Policies on Geometric Highway Design." It includes seven separate policy subjects—grade separations for intersecting highways; intersections at grade; highway types (geometric); rotary intersections; sight distances; highway classifications; criteria for marking and signing no-passing zones on 2- and 3-lane roads. Also includes design standards for the interstate, primary and secondary systems. Price \$3.25 per copy ordered direct from the Association.

INSTRUCTIONS TO BITUMINOUS Plant Inspectors

How the Michigan state highway department instructs its inspectors is given in this summary, from the department's Construction Manual. Data on batch-type plants and on routine inspection in general are included. The Manual's sections on continuous-type plants and on sampling are omitted for lack of space.—Editor

THESE instructions are for the guidance of Bituminous Plant Inspectors, and this section contains information for the control of the bituminous mixtures under the Standard Specifications for

(I) Oil Aggregate Surface Course, Mich. Class B-2

(II) Bituminous Aggregate Surface Course, Mich. Class C-1

(III) Bituminous Aggregate Surface Course, Mich. Class F-1

(IV) Bituminous Concrete, Mich. Class I

(V) Sheet Asphalt, Mich. Class J

The Inspector must review the Standard Specifications and should also check with the Project Engineer regarding any supplemental specifications that may be included in the proposal or plans that apply to the particular project at hand.

The Plant Inspector's function is to guarantee the quality of the bituminous mixtures. This involves a constant checking of the qualities of the various ingredients and their proportions in the mixtures, also temperatures, drying, and mixing requirements and the keeping of records regarding such operations.

General Conduct and Relationship

Bituminous Plant Inspectors are under the jurisdiction of the Project Engineer whom they should consult whenever they are in doubt in making a decision. In all matters pertaining to materials or design and control of the mix, the instructions of the Testing and Research Division and its representatives assigned to this work should be followed.

Cooperation with the Street Inspector is essential to good results and will be required. Avoid sending out loads when the weather or other conditions will not permit placing operations. Find out whether the mixture functions properly during placing and compacting operations. The Department will require telephone facilities, whenever feasible, so that unforeseen difficulties can be reported immediately.

Keep field laboratory and equipment clean and orderly. The appearance of your laboratory and reports is an indication of your efficiency. Periodic inventories should be made.

See that instructions given to the Contractor are followed. If there are

any violations of specifications or instructions or misunderstandings that cannot be worked out promptly, notify the Project Engineer.

Maintain an attitude of cooperation and helpfulness with the Contractor and his organization, consistent with these instructions. Be careful not to delay operations unless necessary, as continuous plant operation is required to keep the finishing machine operating without interruption, as well as from a standpoint of cost to the Contractor.

The Assistant Plant Inspector's place is around the plant watching operations. He is to work under the direction of the Plant Inspector whom he may assist by taking plant samples or any duties outside of the field laboratory. The Plant Inspector must personally make all tests and keep all records.

Proportioning Computations

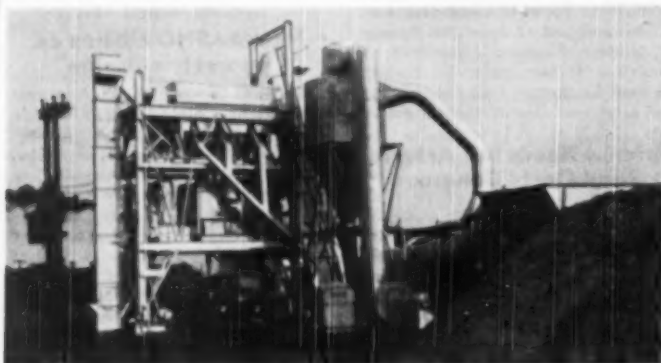
These computations are of two general systems: continuous mix plants and batch type plants. Continuous mix plants are limited to the production of mixtures under Bituminous Aggregate mixtures, both Class C-1 and Class F-1, while the batch plants are permissible for the production of all classes of mixtures under the scope of these instructions. [Continuous mixing instructions omitted from this article.]

Computation of Mix Proportions for Batch Plant Operations

In Sheet Asphalt (V) and Bituminous Concrete (III and IV) both for binder and wearing course mixtures, the raw aggregates are put through a drier to remove the moisture and then separated by screening into fine and coarse aggregate fractions. These separated materials are then recombined by weight with the necessary amount of mineral filler and bitumen to make a mixture having the composition designated by the Engineer within the specification limits.

The following tables list the specification requirements for the various types of mixtures with an example for each of a designated mix composition within the specification limits.

While it appears that these designated mix proportions could be ob-



★ Some county, municipal and other agencies have need to strengthen and clarify their plant inspection requirements as an aid to better quality of bituminous plant-mix construction. Cedarapids hot-mix plant shown set up for typical contractor operation along rail siding.

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tained by just weighing portions from the stone bin, sand bin, and mineral filler bin amounts equivalent to the percentage values desired, this is not possible because of "outside" fractions in these bins. These "outside" fractions are enumerated as follows:

1. Mineral Filler contains a fraction which is retained on the No. 200 sieve. This "outside" fraction of mineral filler is therefore included in the fraction of the mixture retained on the No. 200 sieve.

2. The coarse aggregate in the stone bin contains a fraction which will pass a No. 10 sieve. This "outside" fraction will be included in the fraction of the mixture which passes the No. 10

sieve and is retained on the No. 200 sieve.

3. The fine aggregate in the sand bin contains both a fraction retained on the No. 10 sieve and a fraction which passes a No. 200 sieve. Therefore, these fractions would be normally included in their respective size fraction in the mixture analysis rather than in the fraction passing the No. 10 sieve and retained on the No. 200 sieve.

Therefore, in setting up the weights to draw from each bin for a batch of mixture, it is necessary to allow for these "outside" fractions and balance the weights to give the required mixture analysis. To explain the compu-

tations, the following example is used.

The mixture analysis desired is shown in the last column of Table 3 or 4. In addition, the actual gradation tests on the bins of stone, sand, and mineral filler are listed in the respective columns of this table. In working out the trial mix, a 100-lb. batch is assumed for basis of computations. The principle is to use batch weights equivalent to the desired mix analysis proportions and compute a trial mixture composition, finally correcting the batch weights for the amount over or under the desired mix composition.

Sample Batch Computed

In this example, a 100-lb. batch, made up of 55 lb. of stone, 34 lb. of sand, 5.5 lb. of mineral filler and 5.5 lb. of bitumen is taken. To compute the fraction of the mix retained on No. 10 sieve it is noted that the stone bin analysis shows 92% of this material retained on the No. 10 sieve. Therefore only 92% of the 55 lb. taken from this bin is retained on the No. 10 sieve. Multiplying then $0.92 \times 55 \text{ lb.} = 50.6 \text{ lb.}$ retained on No. 10. In the sand bin 2% of the 34 lb. drawn for the batch from this bin is retained on the No. 10 sieve. Multiplying $0.02 \times 34 \text{ lb.} = 0.7 \text{ lb.}$ retained on No. 10 sieve. Adding these two together $50.6 + 0.7 = 51.3 \text{ lb.}$ retained on No. 10 sieve. However, 55% is desired on the No. 10 sieve. This combination therefore is 3.7 lb. lower than what is desired on the No. 10 sieve. The batch is therefore corrected by adding 3.7 lb. to the stone bin weight making 58.7 lb. to draw from this bin.

Similarly the fraction passing the No. 10 and retained on the No. 200 sieve is computed.

Stone bin	0.08×55	$= 4.4$
Sand bin	0.96×34	$= 32.6$
Mineral filler	0.22×5.5	$= 1.2$

Total Passing No. 10, retained on No. 200 sieve = 38.2

This quantity of 38.2 lb. is 4.2 lb. high and therefore the sand weight of 34 lb. is corrected by subtracting 4.2 lb. from it making the corrected weight 29.8 lb. Similarly the weight of mineral filler is corrected as follows to give the proper amount passing the No. 200 sieve in the mix.

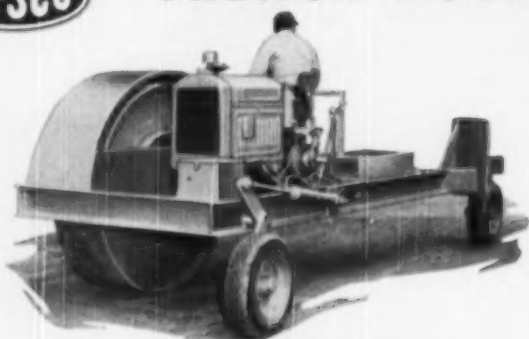
Sand bin	0.02×34	$= 0.7 \text{ lb.}$
Mineral filler	0.78×5.5	$= 4.3 \text{ lb.}$
Total passing No. 200 sieve		$= 5.0 \text{ lb.}$
5.5 lb. - 5.0 lb.		$= 0.5 \text{ lb. low}$
5.5 lb. + 0.5 lb.		$= 6.0 \text{ lb.}$
mineral filler required for the corrected batch weight		

The corrected batch weights therefore are as follows:

Stone bin	58.7 lb.
Sand bin	29.8 lb.
Mineral filler	6.0 lb.
Bitumen	5.5 lb.
	100.0 lb.



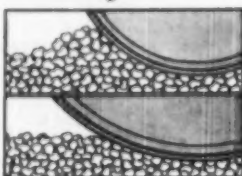
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These corrected batch weights are for a 100-lb. batch and are equivalent to the per cent of a batch of any size. For example a 2500-lb. batch would require 25 times the above batch weights.

25 x 58.7 lb.	= 1467 lb. stone bin
25 x 29.8 lb.	= 745 lb. sand bin
25 x 6.0 lb.	= 150 lb. mineral filler
25 x 5.5 lb.	= 138 lb. bitumen
2500 lb.	

The following tables give examples for computing batch weights for bituminous concrete, sheet asphalt, and binder mixture. These latter two are less complicated in that sheet asphalt contains no stone, and binder contains no mineral filler. Therefore, the balance only involves two materials with these mixtures rather than the three in bituminous concrete wearing course mixture.

Routine Inspection

In addition to sampling and testing of materials, there are numerous other details that the Plant Inspector must constantly keep in mind. These items of inspection are of considerable importance and should be closely watched by the Inspector. Check the following items as they apply, according to the specific specification requirements for the type of equipment under the bituminous type being produced.

Approval of Materials. Check with the Project Engineer to determine whether approval has been received on aggregates tested by the Testing and Research Division.

Check on Batching Operations. Check the tare of the batch scales several times during the day, especially the asphalt scale. The asphalt scale tare should be checked at the start of operations for several batches, until the bucket becomes thoroughly heated, and gives a uniform run-off. This will also apply after any prolonged delays during the day.

Other causes of variation of the tare weight can be due to accumulation of wastes on the weigh-box, or due to vibration, loosening of the tare weights. Other causes of inaccuracies in scales can be due to accumulation of dust, stone, etc., in the various close clearances of the moving parts in the weighing setup. Therefore, all such appurtenances should be kept clean. Dial faces should be kept clean for accurate reading.

Mixing Operations. Satisfy yourself that the mixer men are conducting the mixing operations as required by the specifications. Carelessness or deliberate inaccuracy will not be tolerated. Specifications have a definite control on the human element of batch weighing under the item of "Proportioning Mixtures," which requires the

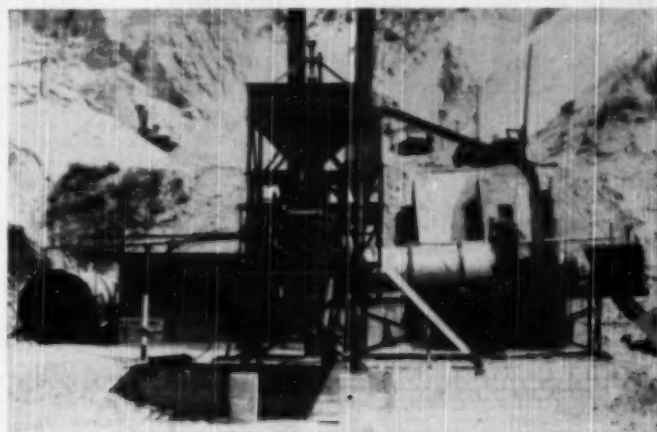
weighman to maintain an accuracy of 2% of the batch weights. Therefore, each truck should weigh within plus or minus 2% of the theoretical weight. If not, the load is subject to rejection. Therefore, for a 5-ton batch load, the total weight should be within plus or minus 200 lb. of the 10,000 lb.

Changes in Batch Scale Weights. Do not make radical changes in the mixture without written authorization. Slight changes will be permitted, but if the mixture is still unsatisfactory, the Laboratory should be notified.

Pyrometers. Recording pyrometers for aggregate temperatures must be checked for accuracy and sensitivity. These can be checked with the kit

thermometer by placing the couple and thermometer in a pail of hot water or hot sand and comparing readings. Any heavy armour on the couple retards the sensitivity and is unnecessary because there is very little wear on the stem as placed in the sand bin. The specifications state the requirements on sensitivity and this can be checked with a pail of hot sand.

In case the recorder is out of order after operations have begun, the Contractor should be allowed a reasonable time to have it repaired or adjusted. The Inspector should never attempt to adjust these instruments; have the Contractor's men do any adjusting necessary. If the Contractor makes



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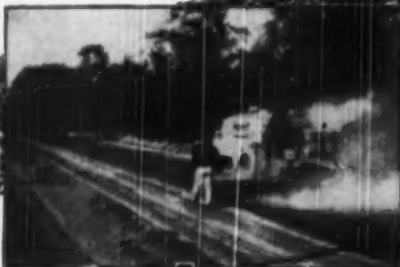
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Table 1—Michigan Mix Specifications

Element of Mix	Specification	Desired Mix
Bituminous Concrete		
Retained on No. 10	60–65%	55%
Pass. No. 10, Ret'd. on No. 200	25–40%	34%
Passing No. 200	4.5–6.5%	5.5%
Bitumen		
Shovel Asphalt		
Retained on No. 10	6–8%	
Pass. No. 10, Ret'd. on No. 40	10–20%	Varies with road grading
Pass. No. 40, " " No. 80	25–45%	
Pass. No. 80, " " No. 200	15–30%	
Passing No. 200	10–20%	14.5%
Bitumen	9.5–12%	10.0%
Binder Mixture		
Retained on No. 10	60–80%	78%
Passing No. 10	15–35%	22.5%
Bitumen	4–6%	4.5%

Table 2—Computing Batch Weights

Mixture Fractions	Stone Bin Analysis	Sand Bin Analysis	Filler Analysis	Bitumen Analysis	Trial Computations	Mix Computations	Mix Design %
% Ret. #10 Sieve	92	2	0	0	.92 x 55 = 50.6	55.0	
					.02 x 34 = 0.7	-81.3	85
						51.3	
						under	3.7
% Pass. #10 Sieve and #200 Sieve	8	96	22	0	.08 x 55 = 4.4		
					.96 x 34 = 32.6	38.2	34
					.22 x 5.5 = 1.2	-34.00	
						38.2	
						over	4.2
% Pass. #200 Sieve	0	2	78	0	.02 x 34 = 0.7		
					.78 x 5.5 = 4.3	5.5	5.5
						-5.0	
						under	0.5
Bitumen	0	0	0	100	1.00 x 5.5 = 5.5		5.5
Total	100	100	100	100			100
Batch Weights	80.0	34	5.5	5.5			
Correction	+3.7	-4.2	+0.5	0			
Corrected							
Batch Weight	83.7	29.8	6.0	5.5	= 100 lb.		

Table 3—Mix Calculations for Binder

	Stone Bin Analysis	Sand Bin Analysis	Bitumen Analysis	Trial Computations	Mix Computations	Mix Design %
% Ret. on No. 10 Sieve	94	2	0	.94 x 73 = 68.6		
				.02 x 22.5 = .5	73	73
					69.1	
					Under	3.9
% Pass. No. 10 Sieve	6	98	0	.06 x 73 = 4.4		
				.98 x 22.5 = 22.0	26.4	
					26.4	22.5
					Over	3.9
Bitumen	0	0	100	1.00 x 4.5 = 4.5		4.5
Total	100	100	100			100
Batch Weights	73	22.5	4.5			
Correction	+3.9	-3.9	0			
Weight	76.9	18.6	4.5	= 100 lb.		

BITUMINOUS ROADS AND STREETS

Table 4—Mix Calculations for Sheet Asphalt

	Sand Bin Analysis	Filler Analysis	Bitumen Analysis	Trial Computation	Mix Design %
% Ret. #100 Sieve	94	18	0	$.94 \times 75.5 = 71.0$ $.18 \times 14.5 = 2.6$	73.6
				76.6	75.3
				Over	1.1
% Pass. #100 Sieve	2	82	0	$.02 \times 75.5 = 1.5$ $.82 \times 14.5 = 11.9$	13.4
				13.4	13.4
				Under	1.1
Bitumen Total	0	0	100	$1.00 \times 10.0 = 10.0$	10.0
	100	100	100		100.0
Batch Weight	75.5	14.5	10.0		
Correction	-1.1	+1.1	0.0		
Corrected Batch Weight	74.4	15.6	10.0	$10.0 = 100$ lb.	

the drum or reduce the speed of rotation, either of which would tend to slow the passage of the aggregate through the drier. After rains, etc., when the aggregates are wetter, some gain in more proper drying can be obtained by cutting the feed, but this is limited.

There are cases when an increased dry mix time will help aerate the aggregate. In all cases, any increase in mixing time should be on the dry mix

cycle. Such adjustment should be upon direct recommendation of the Laboratory's field representative.

It is always advisable to operate with the bin storage filled to capacity as this adds to the length of time for the absorbed moisture to sweat out of the aggregate.

In controlling heats, it is essential that the cold aggregate feeder be set for a constant amount and the heats controlled by adjusting the burner.

For high type mixtures, specifications require a definite control within a narrow range on heats as on high type work fairly uniform temperatures are necessary for quality work through the spreaders.

The Small Contractor and the County Road Commission

Published in "Highways and Byways," County Road Association of Michigan, Al. O. Cuthbert, Editor.

By L. J. Hendryx

Engineer-Manager, Cass County Road Commission

A candid and fair analysis, which applies to many states. Do contractor readers of ROADS AND STREETS agree? —Editor

THE contractor that I want to talk about is one who has enough equipment to grade a mile or two of road, one with a gravel plant capable of putting out some 3,000 or 4,000 cubic yards of gravel, one whose overhead costs are comparatively small, one who wants to build a business by doing unspectacular work efficiently and well.

Not so very many years ago, there were a good many contractors who filled these specifications, and a large percentage of county road work was done by them. Now, they are scarce, for several reasons.

(Continued from page 91)

If the moisture content was near 5% it was generally possible to process or mix about one mile per day with four motor graders, using two graders ahead preparing another mile for the next day's work and the other two graders behind laying out or placing the mile previously mixed.

The quality of riding surface secured and the finished appearance of the bituminous surface depended greatly on the skill of the two grader operators doing the placing and to some extent the rolling which, of course, is the last operation.

The cost of the bitumin on this job was about 11¢ per gal, F.O.B., Grandview, and was purchased by the state direct. The cost of heating, hauling, and applying was about 3½¢ per gal. Blade-mixing, placing, rolling and finishing came to about \$900 per mile.

H. B. Curry is county highway commissioner of Bayfield County, Wisconsin.

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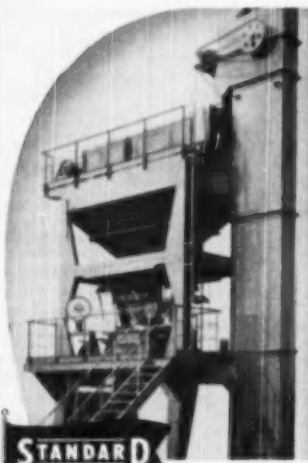
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For one thing, many of them have grown big, just naturally in the course of time. For another thing, the greed for large profits and the desire to have sufficient resources to qualify for State highway construction projects have combined to eliminate, to a large extent, the small start that used to be the normal way to enter business. Now, most of them start "medium" big.

[Editor's Note: The general impression entertained by many local governmental administrators and small contractors is that the Michigan state highway department prequalifies only those contractors who have the finances and equipment to do moderately large and large jobs. This is incorrect. All contractors, who submit financial, equipment and experience questionnaires for pre-qualification, are given the rating to which they are entitled. This rating is a work guide for themselves and a protection for the governmental agencies letting highway contracts.]

At any rate, there aren't very many places in Michigan today where competitive bids would be submitted on the ordinary modest county road construction projects. Federal-aid secondary jobs, of course, do not fall into this classification; most of them are large enough to attract the contractor who normally bids on State projects.

Most county road commissions, rightly or wrongly, have grown into construction organizations. This has



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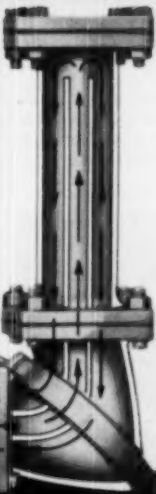
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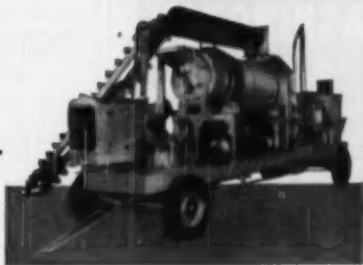
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been a gradual process. Usually, a road commission got into the business first by buying some grading equipment to handle minor maintenance jobs. Then it seemed economical to buy a gravel pit or two, rather than to pay the going prices for small quantities of material from private pits. This made it necessary to obtain gravel processing machinery. It doesn't pay to let expensive equipment like this stand idle, so the counties began making all of their own gravel, and stopped buying from commercial sources. To get the gravel from the pits to the jobs, trucks were needed, then more trucks.

Another factor in the development of the county road commission as a construction agency, of course, can be blamed directly upon the contractors as a group. There have been several instances, where in order to get a job done, the commission had to do the work itself because contractors failed to bid for the work. Maybe they were busy on larger projects. Maybe they just lost interest. Maybe the larger contractors discouraged entry into the field by new, young firms, because they feared eventual competition.

At any rate, the fact remains that someone had to get the equipment and build the roads. And the further fact remains that a county road com-

mission or a municipality, once it is equipped, is pretty certain to operate from then on as a force account agency, without even considering contract work.

As a result, almost every county road commission has a lot of money tied up in all kinds of equipment. It needs men, not only to operate the equipment, but to keep it in repair. Investment is required to maintain a large stock of repair parts. Book-keeping responsibilities have increased. It takes time and effort to train the men and to get them to operating in an efficient manner.

Then comes the problem of finding enough money to keep the crews and equipment working. Under the contract system, if your money gives out, you just don't schedule more work. Under the force account system, you hate to let the equipment sit idle, or to lay off a bunch of men at the beginning of winter, when there are no other jobs available for them. You make every effort to hang onto your good men, at least, so that you will have them the following year.

Can anything be done about all this? If so, should it be done? The answer to both questions, I think, is "maybe." Of course, this isn't any answer at all, except that it indicates that we might well do a little thinking on the subject. The small contractor may be the answer to some of the many problems every road commission is facing.

To start with, it would be necessary to get the contractors in the proper frame of mind. When the subject is mentioned to most of them they will comment about like this: "Get several jobs close together so we can bid on them all at once, or we can't give you a good price."

This doesn't quite make good sense. No one expects a contractor to move all the way across the State to do the average road commission job.

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The Ideal Situation

The ideal situation would arise when there were enough small contractors in the area to provide true competitive bidding and enough work in prospect in the area to provide jobs for most of them most of the time. They would have occasional moving expenses, of course. Probably, they would pay somewhat higher wage scales than do the road commissions. On the other hand, they probably would become extremely efficient in their operations, they certainly would be operating on their own invested capital instead of on the counties', and they should be smart enough to give the public just a little more than its money's worth, which any business man has to do to succeed.

In justice to the counties, it should be emphasized that all of them are anxious to do a good job, a job that will stand up, and they may even do more than the original plans call for, to insure quality in the road.

I do believe that it is obvious, that by letting contract jobs and providing proper inspection, the counties could eliminate or cut down on the amount of money tied up in equipment and parts, cut down the large force of employees, and be able to show accurate construction costs.

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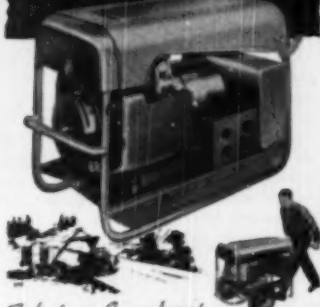
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Research Committee to Study Administration

Harmer E. Davis, director of the Institute of Transportation and Traffic Engineering at the University of California, has been named chairman of the Highway Research Board's Committee on Highway Organization and Administration.

Broad purpose of this committee is to study the organization and management of highway activities on all government levels with respect to organizational forms, efficiency, extent of jurisdiction, and specific functions.

The present committee will devote its attention particularly to road-department organization in county and city governments.

Other members of the committee are Hal H. Hale, executive secretary, American Assoc. of State Highway Officials; G. Donald Kennedy, consulting engineer and assistant to the president, Portland Cement Assoc.; Donoh W. Hanks, assistant director, American Municipal Assoc.; Norman Heiden, Bureau of Highway Traffic, Yale University; C. M. Nelson, editor, *Better Roads*; Ben H. Petty, professor of highway Engineering, Purdue University; L. S. Tuttle, assistant to the commissioner, U. S. Bureau of Public Roads; and W. L. Haas, U.S. Bureau of Public Roads, secretary.

Four New Members Join Asphalt Institute

The Asphalt Institute, New York, N. Y., a national, non-profit organization of the petroleum asphalt industry promoting the development and use of asphaltic products, at its recent Board Meeting increased its membership to forty companies, electing: Empire Petroleum Co. of Denver, Colo.; Pan-Am. Southern Corp. of New Orleans, La.; Southland Oils, Inc. of Rogers, La.; A. Johnson Co. of Sweden.

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Valuable Shovel Operating Data

Developed by Research Board's committee study of equipment operating delays.

"Dipper Load Cycle Characteristics of Power Shovels on Highway Grading Jobs"; Committee Report No. 5, Committee on Economics of Highway Construction and Maintenance Methods Department of Economics, Finance, and Administration of the Highway Research Board.

EQUIPMENT performance studies being conducted by the Production Cost Unit of the Public Roads Administration disclose that the average dipper load cycle time of power shovels on highway grading jobs is slightly over 24 seconds, exclusive of all delays. The average pay yardage per dipper load is found to be 62% of the rated capacity of the dipper on the jobs which were studied.

These findings were obtained from studies made in recent months on 16 crawler type power shovels on 10 different projects in eastern and south-eastern states. The shovels averaged 4 to 5 years of age and were in good operating condition. The rated capacity of the dippers varied from 1 1/4 to 2 1/2 cu. yd.

Table 1 is a composite summary for all jobs of the data relating to the dipper cycle elements and pay yardage per dipper load.

The cycle data were obtained by timing several thousand individual cycles. Practically all observations were

made while the shovels were loading hauling units. The average pay yardage per dipper load was computed on each job from dipper load counts and the corresponding cubic yards of excavation obtained from cross sections. The character of the excavation varied on each job as well as between jobs from "easy digging" in light sandy materials to "hard digging" in poorly blasted rock.

The ranges shown in Table 1 are job averages. On several of the projects the variations from day to day frequently exceeded the ranges which are

such factors as condition and type of shovel, kind of material, boom angle, dipper pitch, height of digging face, operator efficiency, type and size of hauling unit, and so on.

Certain general observations of performance on the various jobs are of interest, however. For example, the smallest pay yardage in relation to rated dipper capacity was observed when working against a one-foot face digging up an old portland cement concrete pavement. The longest average loading and dumping times were encountered in material classified as "wet, sticky clay." In this material it is interesting to note that the pay yardage in relation to rated dipper capacity was above the average for the remaining jobs.

As might be expected, smaller pay yardage in relation to rated dipper capacity and slightly longer average

Table 1—Summary of average dipper load cycle data for 1 1/4 to 2 1/2 cubic yard power shovels on highway grading jobs.

Element	Range	Average
1. Load	6-15 seconds	8.9 seconds
2. Swing	4-10 seconds	5.8 seconds
3. Dump	7-8 seconds	3.1 seconds
4. Return	5-9 seconds	6.3 seconds
5. Total dipper load cycle (sum of items 1, 2, 3, and 4)	19-35 seconds	24.2 seconds
6. Angle of swing	61-105 degrees	86 degrees
7. Average pay yardage per dipper load	35-88% of rated capacity of dipper	62% of rated capacity of dipper

*Excludes all delays.

shown. For example, the loading time on a particular job may have varied from 5 to 20 seconds, but only the over-all job average was considered when listing the entries in Table 1.

Sufficient studies have not yet been made to warrant analyses of the individual effect upon dipper cycle elements and pay yardage per dipper of

loading times were experienced when working in blasted rock. In well blasted rock, the shovel performance with respect to cycle and pay yardage was equal to or better than the average for the other jobs studied.

Plan World's Longest Suspension Bridge

Dr. David B. Steinman, bridge designer of New York City, has been engaged by the Associazione Fra I Costruttori in Acciaio Italiani of Milan (Milan Association for Steel Construction) to prepare studies for a proposed bridge across the Straits of Messina between Italy and Sicily. This is the legendary site of the classical Scylla and Charybdis, and is of particular interest today since the World War II invasion of Sicily and Italy. The structure would be the largest suspension bridge in the world over the most difficult site ever considered. The crossing is two miles wide with a depth of 400 ft. all the way across. A swift current and storm exposure mark the Straits.

There would be a main span of 5000 ft. with two side spans of 2300 ft. each; 9600 ft. between anchorages. The bridge is planned to carry a railroad and a highway. When constructed it would represent a major step in Italy's plans for industrial and agricultural expansion.

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Mower Sickles Sharpened In a Jiffy

This contraption, operated by the fellow while comfortably smoking a pipe, is a grinder hook-up which has won enthusiastic friends in the Racine County (Wis.) highway department shop. Nothing much need be said about it except that it consists of a small bench grinder unit and a motor, mounted on a piece of old crusher screen and a frame, bolted to the shop floor. The grinder is fitted with a beveled unit suitable for the job at hand.

Standard Plans for Drive- ways in Louisiana

*From Highway Research Board Cor-
relation Service, Circular No. 62*

Persons desiring to construct drive-ways to state highways in Louisiana must submit applications for permits to the State Department of Highways. The application (Form 591, Driveway Permit) issued by the department must include a sketch of the proposed driveway and, in certain instances, must be accompanied by a guarantee deposit which is returned to the applicant upon satisfactory completion of the work.

A pamphlet entitled "Standard Plans for Driveways" has been issued by the department of highways for the guidance of those desiring to construct such driveways. This pamphlet contains sketches of private driveways, private and commercial driveways, commercial establishment driveways and rural mail box locations, as well as a sample permit form. Figs. 1 and 2 reproduced from the pamphlet illustrate an acceptable design for a private or commercial driveway. An outstanding feature of this particular design is the ample parking area provided in the rear and at the sides of the property.

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SHREDDERS: 12" x 16", 16" x 24", 24" x 36", 36" x 48", 48" x 60", 60" x 72", 72" x 84", 84" x 96", 96" x 108", 108" x 120", 120" x 132", 132" x 144", 144" x 156", 156" x 168", 168" x 180", 180" x 192", 192" x 204", 204" x 216", 216" x 228", 228" x 240", 240" x 252", 252" x 264", 264" x 276", 276" x 288", 288" x 300", 300" x 312", 312" x 324", 324" x 336", 336" x 348", 348" x 360", 360" x 372", 372" x 384", 384" x 396", 396" x 408", 408" x 420", 420" x 432", 432" x 444", 444" x 456", 456" x 468", 468" x 480", 480" x 492", 492" x 504", 504" x 516", 516" x 528", 528" x 540", 540" x 552", 552" x 564", 564" x 576", 576" x 588", 588" x 600", 600" x 612", 612" x 624", 624" x 636", 636" x 648", 648" x 660", 660" x 672", 672" x 684", 684" x 696", 696" x 708", 708" x 720", 720" x 732", 732" x 744", 744" x 756", 756" x 768", 768" x 780", 780" x 792", 792" x 804", 804" x 816", 816" x 828", 828" x 840", 840" x 852", 852" x 864", 864" x 876", 876" x 888", 888" x 900", 900" x 912", 912" x 924", 924" x 936", 936" x 948", 948" x 960", 960" x 972", 972" x 984", 984" x 996, 1000.
GRINDERS: 12" x 16", 16" x 24", 24" x 36", 36" x 48", 48" x 60", 60" x 72", 72" x 84", 84" x 96", 96" x 108", 108" x 120", 120" x 132", 132" x 144", 144" x 156", 156" x 168", 168" x 180", 180" x 192", 192" x 204", 204" x 216", 216" x 228", 228" x 240", 240" x 252", 252" x 264", 264" x 276", 276" x 288", 288" x 300", 300" x 312", 312" x 324", 324" x 336", 336" x 348", 348" x 360", 360" x 372", 372" x 384", 384" x 396", 396" x 408", 408" x 420", 420" x 432", 432" x 444", 444" x 456", 456" x 468", 468" x 480", 480" x 492", 492" x 504", 504" x 516", 516" x 528", 528" x 540", 540" x 552", 552" x 564", 564" x 576", 576" x 588", 588" x 600", 600" x 612", 612" x 624", 624" x 636", 636" x 648", 648" x 660", 660" x 672", 672" x 684", 684" x 696", 696" x 708", 708" x 720", 720" x 732", 732" x 744", 744" x 756", 756" x 768", 768" x 780", 780" x 792", 792" x 804", 804" x 816", 816" x 828", 828" x 840", 840" x 852", 852" x 864", 864" x 876", 876" x 888", 888" x 900", 900" x 912", 912" x 924", 924" x 936", 936" x 948", 948" x 960", 960" x 972", 972" x 984", 984" x 996, 1000.
ROLLERS: 12" x 16", 16" x 24", 24" x 36", 36" x 48", 48" x 60", 60" x 72", 72" x 84", 84" x 96", 96" x 108", 108" x 120", 120" x 132", 132" x 144", 144" x 156", 156" x 168", 168" x 180", 180" x 192", 192" x 204", 204" x 216", 216" x 228", 228" x 240", 240" x 252", 252" x 264", 264" x 276", 276" x 288", 288" x 300", 300" x 312", 312" x 324", 324" x 336", 336" x 348", 348" x 360", 360" x 372", 372" x 384", 384" x 396", 396" x 408", 408" x 420", 420" x 432", 432" x 444", 444" x 456", 456" x 468", 468" x 480", 480" x 492", 492" x 504", 504" x 516", 516" x 528", 528" x 540", 540" x 552", 552" x 564", 564" x 576", 576" x 588", 588" x 600", 600" x 612", 612" x 624", 624" x 636", 636" x 648", 648" x 660", 660" x 672", 672" x 684", 684" x 696", 696" x 708", 708" x 720", 720" x 732", 732" x 744", 744" x 756", 756" x 768", 768" x 780", 780" x 792", 792" x 804", 804" x 816", 816" x 828", 828" x 840", 840" x 852", 852" x 864", 864" x 876", 876" x 888", 888" x 900", 900" x 912", 912" x 924", 924" x 936", 936" x 948", 948" x 960", 960" x 972", 972" x 984", 984" x 996, 1000.
PULVERIZERS: 12" x 16", 16" x 24", 24" x 36", 36" x 48", 48" x 60", 60" x 72", 72" x 84", 84" x 96", 96" x 108", 108" x 120", 120" x 132", 132" x 144", 144" x 156", 156" x 168", 168" x 180", 180" x 192", 192" x 204", 204" x 216", 216" x 228", 228" x 240", 240" x 252", 252" x 264", 264" x 276", 276" x 288", 288" x 300", 300" x 312", 312" x 324", 324" x 336", 336" x 348", 348" x 360", 360" x 372", 372" x 384", 384" x 396", 396" x 408", 408" x 420", 420" x 432", 432" x 444", 444" x 456", 456" x 468", 468" x 480", 480" x 492", 492" x 504", 504" x 516", 516" x 528", 528" x 540", 540" x 552", 552" x 564", 564" x 576", 576" x 588", 588" x 600", 600" x 612", 612" x 624", 624" x 636", 636" x 648", 648" x 660", 660" x 672", 672" x 684", 684" x 696", 696" x 708", 708" x 720", 720" x 732", 732" x 744", 744" x 756", 756" x 768", 768" x 780", 780" x 792", 792" x 804", 804" x 816", 816" x 828", 828" x 840", 840" x 852", 852" x 864", 864" x 876", 876" x 888", 888" x 900", 900" x 912", 912" x 924", 924" x 936", 936" x 948", 948" x 960", 960" x 972", 972" x 984", 984" x 996, 1000.
CRACKERS: 12" x 16", 16" x 24", 24" x 36", 36" x 48", 48" x 60", 60" x 72", 72" x 84", 84" x 96", 96" x 108", 108" x 120", 120" x 132", 132" x 144", 144" x 156", 156" x 168", 168" x 180", 180" x 192", 192" x 204", 204" x 216", 216" x 228", 228" x 240", 240" x 252", 252" x 264", 264" x 276", 276" x 288", 288" x 300", 300" x 312", 312" x 324", 324" x 336", 336" x 348", 348" x 360", 360" x 372", 372" x 384", 384" x 396", 396" x 408", 408" x 420", 420" x 432", 432" x 444", 444" x 456", 456" x 468", 468" x 480", 480" x 492", 492" x 504", 504" x 516", 516" x 528", 528" x 540", 540" x 552", 552" x 564", 564" x 576", 576" x 588", 588" x 600", 600" x 612", 612" x 624", 624" x 636", 636" x 648", 648" x 660", 660" x 672", 672" x 684", 684" x 696", 696" x 708", 708" x 720", 720" x 732", 732" x 744", 744" x 756", 756" x 768", 768" x 780", 780" x 792", 792" x 804", 804" x 816", 816" x 828", 828" x 840", 840" x 852", 852" x 864", 864" x 876", 876" x 888", 888" x 900", 900" x 912", 912" x 924", 924" x 936", 936" x 948", 948" x 960", 960" x 972", 972" x 984", 984" x 996, 1000.
SPLITTERS: 12" x 16", 16" x 24", 24" x 36", 36" x 48", 48" x 60", 60" x 72", 72" x 84", 84" x 96", 96" x 108", 108" x 120", 120" x 132", 132" x 144", 144" x 156", 156" x 168", 168" x 180", 180" x 192", 192" x 204", 204" x 216", 216" x 228", 228" x 240", 240" x 252", 252" x 264", 264" x 276", 276" x 288", 288" x 300", 300" x 312", 312" x 324", 324" x 336", 336" x 348", 348" x 360", 360" x 372", 372" x 384", 384" x 396", 396" x 408", 408" x 420", 420" x 432", 432" x 444", 444" x 456", 456" x 468", 468" x 480", 480" x 492", 492" x 504", 504" x 516", 516" x 528", 528" x 540", 540" x 552", 552" x 564", 564" x 576", 576" x 588", 588" x 600", 600" x 612", 612" x 624", 624" x 636", 636" x 648", 648" x 660", 660" x 672", 672" x 684", 684" x 696", 696" x 708", 708" x 720", 720" x 732", 732" x 744", 744" x 756", 756" x 768", 768" x 780", 780" x 792", 792" x 804", 804" x 816", 816" x 828", 828" x 840", 840" x 852", 852" x 864", 864" x 876", 876" x 888", 888" x 900", 900" x 912", 912" x 924", 924" x 936", 936" x 948", 948" x 960", 960" x 972", 972" x 984", 984" x 996, 1000.
CHOPPERS: 12" x 16", 16" x 24", 24" x 36", 36" x 48", 48" x 60", 60" x 72", 72" x 84", 84" x 96", 96" x 108", 108" x 120", 120" x 132", 132" x 144", 144" x 156", 156" x 168", 168" x 180", 180" x 192", 192" x 204", 204" x 216", 216" x 228", 228" x 240", 240" x 252", 252" x 264", 264" x 276", 276" x 288", 288" x 300", 300" x 312", 312" x 324", 324" x 336", 336" x 348", 348" x 360", 360" x 372", 372" x 384", 384" x 396", 396" x 408", 408" x 420", 420" x 432", 432" x 444", 444" x 456", 456" x 468", 468" x 480", 480" x 492", 492" x 504", 504" x 516", 516" x 528", 528" x 540", 540" x 552", 552" x 564", 564" x 576", 576" x 588", 588" x 600", 600" x 612", 612" x 624", 624" x 636", 636" x 648", 648" x 660", 660" x 672", 672" x 684", 684" x 696", 696" x 708", 708" x 720", 720" x 732", 732" x 744", 744" x 756", 756" x 768", 768" x 780", 780" x 792", 792" x 804", 804

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- 1—Littleford 100-5 1500 gallon Asphalt trailer.
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- Two (2) Model 80-D Northwest Crane-Shovel-Draglines.
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- Ten (10) 43FDT Euclid Bottom Dump Units.
- One (1) Rea Dual Drum 34-E Paver.
- One (1) LeTourneau Model "W" Scraper.

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Lorain 820 Shovel, 1948

Marion 1½ Yd Dragline

Buckeye ¾ Yd Shovel 1947

Osgood ½ Yd Shovel, Late Model

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T. D. 9 W/Hydraulic B. E. Dozer

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Can be inspected at our plant.
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ESCO 1 1/2 YD. SHOVEL BUCKET

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Mod. 464 Buckeye. Used as demon-
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TEL. 59-5426

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Phone: Wabash 4535

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Three BX Mack Dump Trucks, H.P. Cummins Diesel Engine.
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In excellent condition, can be inspected at our plant. Reason for selling—stepping up production & increasing size of mixers to 4 cu. yd. Will also sell power take-off necessary for above mixer.

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Buckeye & Phoenix trench excavators (6).
Excelsior, 27FD and 40FD bottom.
Crawling, screening, washing plant, 80 ton.
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New 1950 Galion 10-ton, 3-wheel roller,
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These rollers must move—15% off list price.

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Completely rebuilt.

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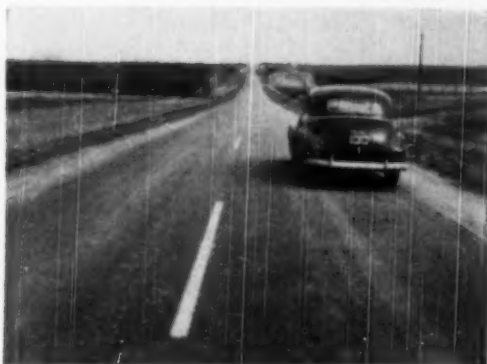
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